MODERN PLASTICS

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Next Month

Gears of paper and canvas which will wear longer than those of steel will be described by H. R. Moyer of the Westinghouse Electric and Mfg. Co. He will tell how the paper and canvas is prepared and impregnated with resins and then laminated with pressure and heat. He will describe the early uses of such gears in the automotive field and will trace their progress up to and including the new molded spoke gears recently introduced. He will explain why they operate with unusual quiet and do not require oil for lubrication. You will want to read this—watch for it in February.

Published the 5th of each month, by Breskin & Charlton Publishing Corporation. Publication office, 20th and Northampton Sts., Easton, Pa. Advertising, editorial and general offices at 425 Fourth Ave., New York, N. Y. Telephone Ashland 4-0655. Western office, 221 N. La Salle St., Room 620, Chicago, Illinois. Telephone Randolph 6336.

PUBLISHERS OF MODERN PACKAGING, PACKAGING CATALOG, MODERN PLASTICS

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MODERN PLASTICS
JANUARY 1937 VOLUME 14 NUMBER 5

MOLDING AN IMPOSSIBLE SHAPE

Undercuts uncovered trouble in this molding operation which could be overcome only by tilting the press at an angle of 55 degrees

by E. F. LOUGEE

THE SPARKLET SYPHON, AN INTERNATIONAL household and bar necessity which has been on the market since 1895, has been redesigned. It has been completely rebuilt along modern lines with innumerable improvements and advantages, and has been so changed in appearance that it scarcely even resembles its predecessor. Although of the same capacity, its weight has been reduced two-thirds (four pounds) which makes it easier to use, especially for women. Its height has been reduced more than two inches so it fits upright conveniently into our modern refrigerators. The new model is slightly higher than a standard quart milk bottle for which ample space is provided in contemporary refrigerator design.

The original Sparklet Syphons were of glass with a raffia covering and were carried to Egypt and India by British soldiers. About twenty-five years ago, the raffia was replaced by wire mesh and no major change has taken place in their appearance until the new model was recently introduced. Now, the familiar glass bottle with its wire mesh protection has been replaced with a drawn metal shell with chromium or enamel finish and is metal lined. It is unbreakable and foolproof because a special patented device within the bottle precludes the possibility of its being overfilled.

The head of the new syphon is again made of Doehler Die Cast tin base alloy which proved so satisfactory on hundreds of thousands of previous Sparklets and the operating lever and tap signature cap are chromium plated Doehler zinc die castings of fine hardware finish. The decorative housing for the head which gives both color and pleasing lines to the new syphon is molded of Plaskon, a urea plastic material, which brings us to the point of our story.

This housing, which consists of three parts (Fig. 4), looks like a comparatively simple molding job but it presented a problem in engineering which was met with heroic departures from the conventional. If you will look at Fig. 2, you will see a 200-ton press, which weighs four and a half tons itself, tipped at an angle of 55 degrees on which the spout half of the housing is being molded in the Boonton Molding Company's plant.

PLASKON

The new Sparklet retains the successful functional advantages of the old with marked improvement in appearance, increased safety and convenience in use. Glass is entirely eliminated, weight and height reduced

To begin at the beginning, it is reported that several molders, after looking over the specifications, decided the housing in its present form was impossible to mold. These specifications eventually reached the hands of George Scribner, president of the Boonton Molding Com-

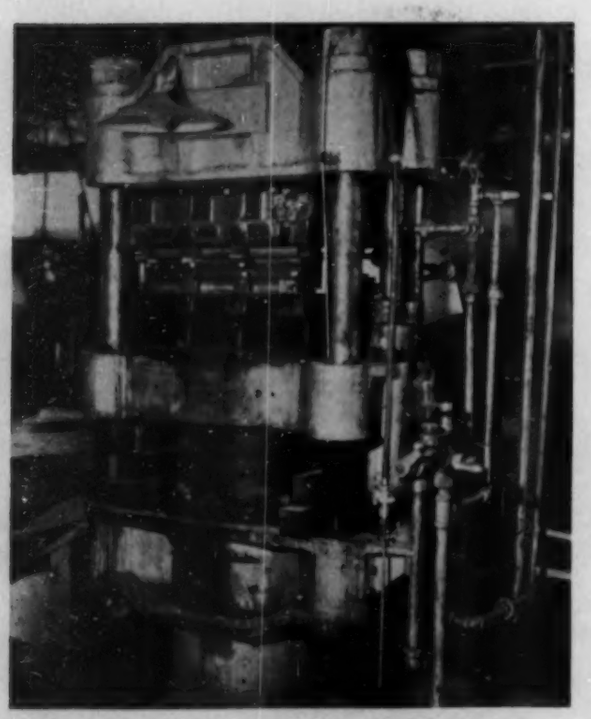
pany, who became interested in the problem and decided it was worth a try. The original idea was to mold the entire head but Mr. Scribner pointed out that this was impractical because he felt that none of the plastic materials are sufficiently resistant to moisture to stand up in such an application. If any moisture is in contact with the inside surface of the cap, and if it absorbs only one-half of one per cent, that absorption increases the inside diameter and with a fixed outside diameter, something should let go sooner or later and it is likely to crack. It was agreed then that the plastic should be used only as a housing over the die cast metal alloy operating mechanism again demonstrating that plastics and die castings when used together in correct application complement each other rather than compete. A set of sample molds was then made.

The rear half of the housing (with opening for cartridge attachment) was comparatively simple. It required a straight up and down movement with no undercuts. The spout side, however, appeared to be physically impossible after a careful analysis of the factors involved. Boonton engineers went into a huddle with John Hohl of the Newark Die Company, who engineered the molds, and it was decided to make a twelve cavity die, six facing one way and six the other so as to relieve the theoretical side pressure.

The problem technically was a quarter ellipsoid with a spout extending at a 55 deg. angle from the convex sur-

Fig. 1. Press and "close-up" of mold and force illustrating the simple operation of molding the filler or cartridge half of the plastic housing. Fig. 2. Nine thousand pound press cocked at an angle of 55 degrees, and strapped securely in place, to permit even flow of plastic material and the removal of undercut parts from the mold. Fig. 3. Twelve cavity mold and its required angle of operation to permit removal of undercut parts caused by the spout which juts out at an angle of 55 degrees from the quarter ellipsoid piece

1



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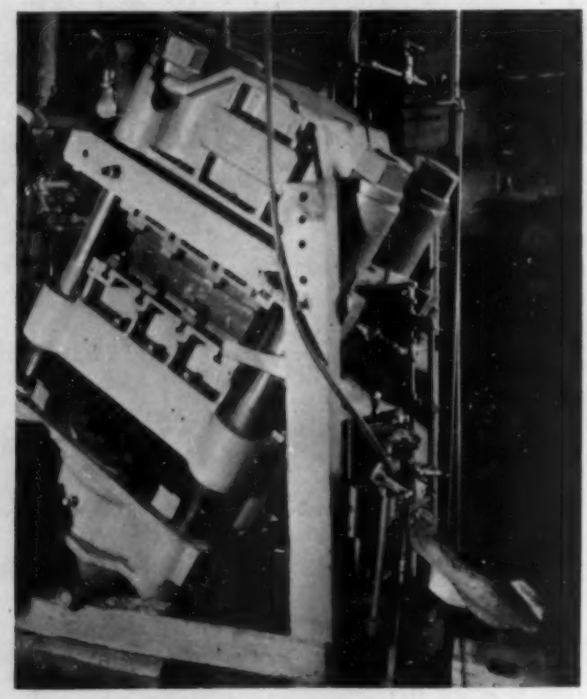

PHOTOS COURTESY BOONTON MOLDING COMPANY

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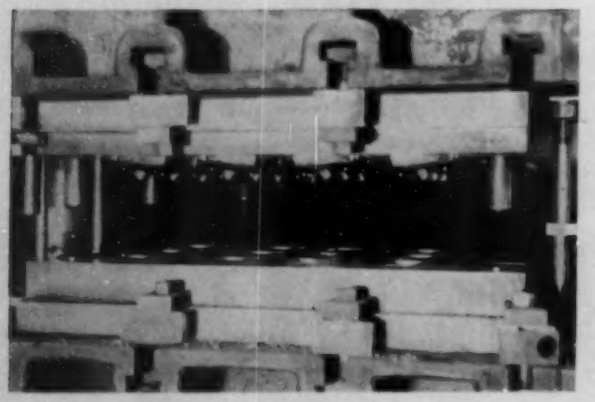
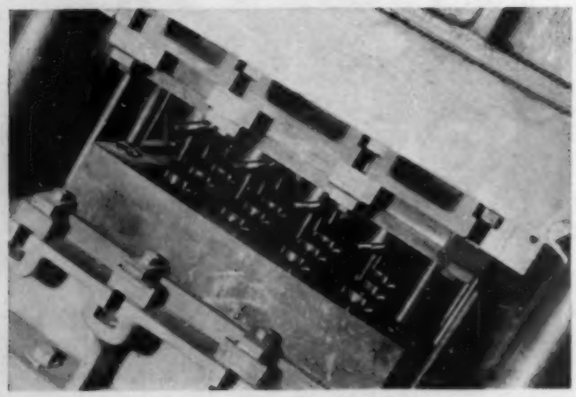




4 COURTESY DOEHLER DIE CASTING CO.

Fig. 4. Assembly parts for the new Sparklet head showing die castings and molded housing —in two parts—and dust cap attached with bead chain at the right. Figs. 5 and 6. Finishing and inspection departments of the Boonton Molding Company where Sparklet tops are molded

5

6

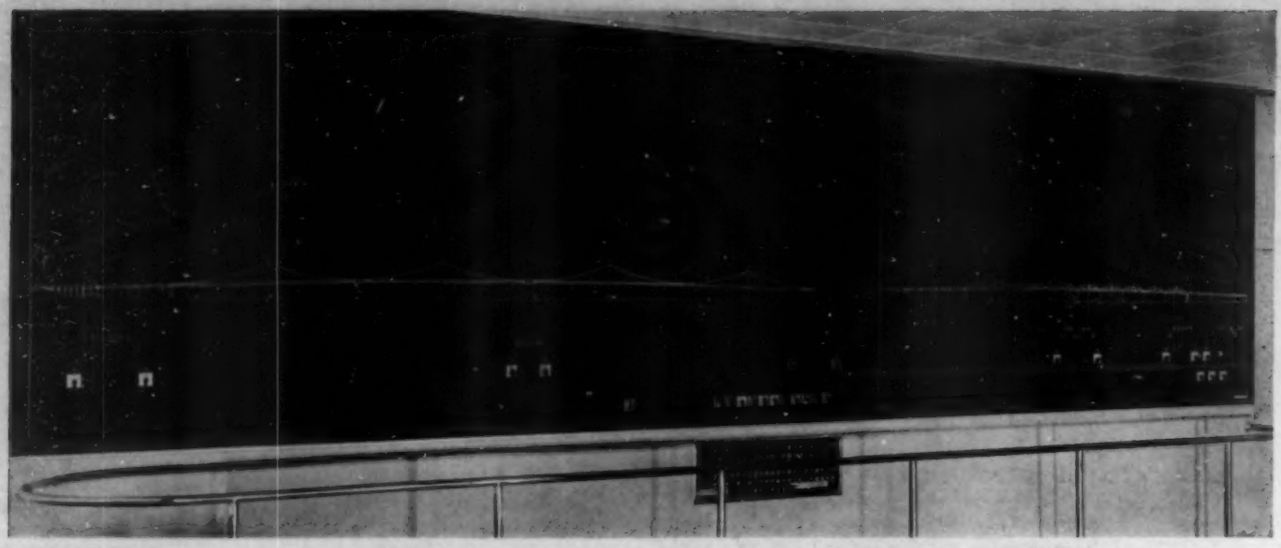
face which had to be tilted the full 55 deg. to permit removal from the mold along the center line of the spout. When this was done, however, it was found that serious undercuts developed because of its rapid decrease in width at the narrow end. In the ejection from the die, the deepest section of the molded part now had to pass by points one half inch further toward the small end, located on the center edge. Some of these undercuts could be eliminated in the design but many had to remain and the part snapped over mechanically.

This meant that a urea material had to be used because of its ability to snap out while hot and come back into its original position without distortion. Phenolic material was tried but the spout was distorted 10 deg. out of line which of course made assembly over the die casting impossible.

When the original mold was put in operation, trouble was uncovered because the material could not be placed properly in the cavity with the result that a heavy flash made exceedingly bad finishing conditions. Not only this, but there was a marked overlapping where the two molded pieces came together through distortion caused in ejecting the spout part.

The solution seemed to be for the cavities to be made flat in the mold and the only way this could be accomplished was to tilt the press at an angle of 55 deg., a procedure unprecedented in the molding industry but one which Boonton Engineers and R. M. McGee, of The Plaskon Co., decided upon as the only solution of a seemingly impossible problem. A new mold was made and so designed that the flash at the edge of the part is extremely thin and easily broken away. Because the two sections of the housing must fit snugly without visible difference in circumference at any point, it was impossible to file or otherwise remove the heavy flash and have them fit. This is obvious because the molded threads required on each section for assembly must be perfectly aligned as can be seen in Fig. 4. Furthermore, any difference in circumference at any point would make a visible seam where the two halves are assembled, another obvious objection. The slight rim at the top of the two halves, which may be seen in Fig. 4, must also fit perfectly as they are held together by a metal crown, or signature cap, die cast to .002 inch.

It is no easy job to tilt a 9000 lb. press at such an angle and especially to anchor it sufficiently at that angle to allow it to function without danger of collapse, but Boonton with characteristic fortitude rigged a block and pulley in the cramped space (*Continued on page 60*)



Laminated plastic control panel, twenty-seven feet long, where each light is indicated in color on a perfectly etched outline of the entire bridge

THE OAKLAND-SAN FRANCISCO BAY BRIDGE

by A. BERTRAND
Plastiform Products Co.

Where laminated plastics occupy a strategic position at the controls and lend their decorative influence to the interior of The Administration Building

THE LAST SPIKE WAS DRIVEN AND LELAND Stanford with his contemporaries had succeeded in joining the Atlantic seaboard to the Pacific with a Transcontinental railway system more than fifty years ago As he stood in the infant community of San Francisco, he looked across San Francisco Bay to the rolling hills of the mainland where Oakland and the East Bay communities were destined to rise and in that moment realized that the future would feel the need of a final connecting link between the mainland of the East shore and the Peninsula of San Francisco whereon he stood.

Section of Toll Plaza showing Administration Building of the Oakland–San Francisco Bay Bridge. All photos courtesy, Plastiform Products Company

Leland Stanford and others of the late 70's and early 80's had vision. The years passed and this idea, impractical in those times, has become reality and reached fruition under the engineering prowess of today. The Oakland–San Francisco Bay Bridge, eight and one quarter miles long, the greatest bridge in the world, is open to traffic and there is plenty of it.

Even in this day, when "millions" are spoken of nonchalantly by all, the statistical figures of various material used for this vast undertaking are incomprehensible to the average mind. Concrete and steel sufficient to erect seven or eight Empire State Buildings—70,815 miles of cable wire—millions of hours of labor—$77,600,000 in money—these are but a few of the cold figures. Thousands of new engineering problems, never before encountered were met and conquered by the superb engineering technique of these times.

Graceful twin suspension bridges, in tandem, span the waters between San Francisco and the island of Yerba Buena where traffic enters a huge bore to emerge on the opposite side of the island onto the great cantilever span connecting with the East Bay Shore. All tolls are

collected at this end of the bridge on the Oakland toll Plaza. Here is located the Bay Bridge Administration Building which houses the clerical force, the bridge traffic patrol, the treasury department, and the bridge control room.

As you drive onto the toll plaza and look through the glassed-in front of the administration building, your eye is immediately attracted by the beautiful, warm, sand-colored walls of the interior which are made up entirely of laminated plastic panels of Micarta. This application of plastic to the walls and steel doors of the administration building also involved the applicators in new problems which were successfully solved. All plastic material used was cut and fitted on the job and was applied over concrete, steel doors, metal lath and other bases.

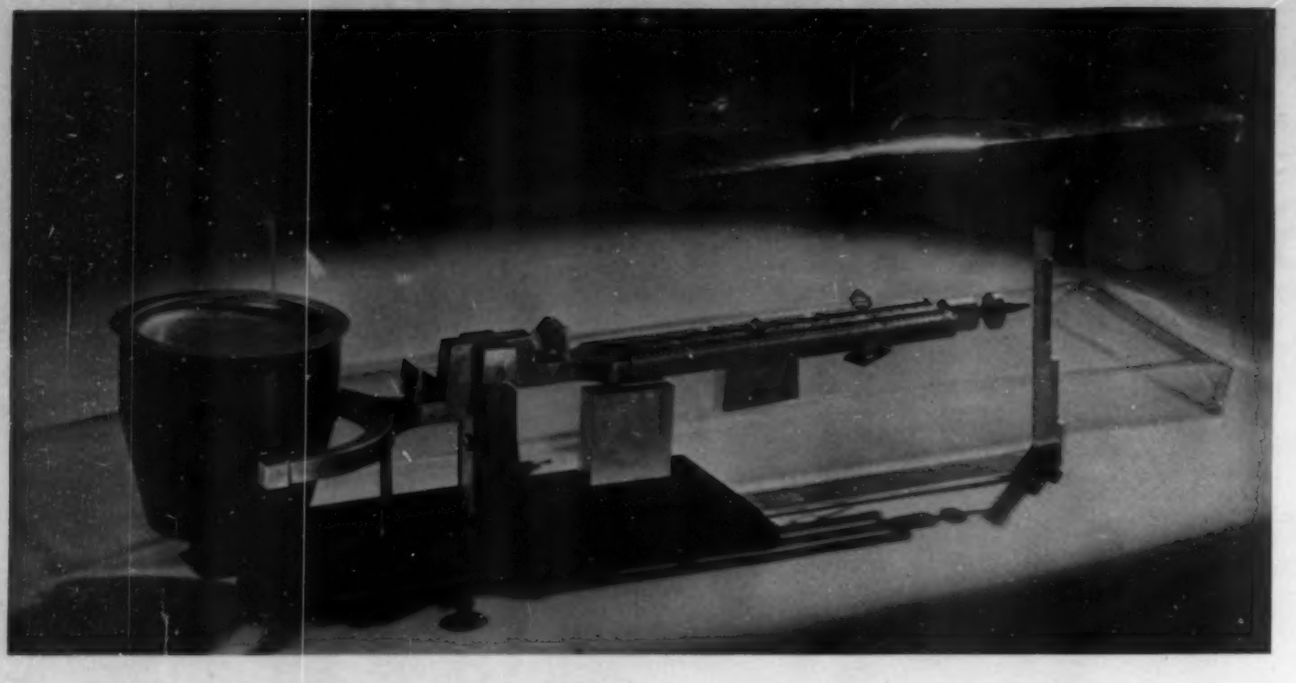
A spacious lobby separates the vaults and toll sergeants' room on the one side from the large control room on the other. All walls are laminated plastic with appropriate chrome metal trim.

A spectacular adjunct of more than ordinary interest is the laminated plastics control board which is set into one wall of the control room. This control panel is made up of "sandwich plate" plastic consisting of a black satin phenolic surface with a white urea subsurface. The panel is 27 feet long and 7 feet in height. The surface of the panel was protected with a layer of rubberized glue. Then a scaled design of the bridge elevation, in detail, together with a full length deck plan was accurately cut through this rubberized coating exposing the black phenolic surface of the panel.

The thousands of suspension cables were "cut in" in 1/8 inch lines. The huge main cables were accurately "cut in" in proportion. Piers, steel structure and all other detail were carefully delineated. Through this large "stencil" the design was then sandblasted to cut away the black phenolic surface and expose the white urea sub-surface. The result—an etched outline of the bridge appearing in white on a black background which will probably last as long as the bridge. The panel was then drilled to allow all bridge lights to be indicated on the control board by miniature indicator lamps set into the panel; red lines and indicator lamps designate navigation control; green lines indicate fog control and orange lines mark roadway lighting control. All pier lights and airway beacons are also shown at their proper geographical location on the board. The panel also incorporates all power supply sectionalizing breakers and control switches to provide for remote control of all equipment not set up for automatic operation. Laminated plastic is admirably suited to this use because of its insulative properties and permanent finish. The possibility of short circuits had to be definitely eliminated from this important control panel.

The idea of synchronized beacon rotation as used on this project, for the protection of air traffic, originated with the engineers of the State of California responsible for the electric design features of the bridge project. This system provides an entirely unique identification of the bridge structure which (*Continued on page 58*)

Control room desk (left) which faces control panel and is occupied by a toll sergeant twenty-four hours each day. Below are views of the sergeants' room, lobby and staircase showing the steel interior walls covered with laminated plastic, and doors which are made of the same material. Chromium strips in interesting pattern hold the panels in place



MOLDED ACCURACY

by H. BENNETT
Chemical Publishing Company

To avoid corrosion and make this scale light enough to carry anywhere, the weighing cup, upright and base are made of plastics. The beam and indicator are of special aluminum alloy. The scale is sensitive to 1/100th grams and will weigh a maximum of 101 grams

THERE HAS BEEN A DEFINITE LATENT NEED for a small, accurate scale available at a low price. Heretofore, accuracy has only been available in scales or balances selling for fifty dollars or more. These precision balances are large and non-portable. They entail expensive repairs when they become worn or damaged. The cheaper balances are not sensitive and are definitely erratic in the weighing results.

To fill this void between the precision and the low priced balances, work was started about eight years ago. Model after model was tested and discarded. About a year ago a model which had been approved by a number of chemists and engineers was placed on the market. Initial advertising was greeted by a flood of orders which swamped the factory. But, as with other new developments, certain faults were noticed. Production was stopped and all efforts were made to overcome them. Model after model was again tried and tested. Consultants were called in. The result after considerable research is the new Bennett Balance.

In order to avoid corrosion and make it light enough to carry about, the weighing cup, upright and base are made of Bakelite. The beam and indicator scale are made of a die cast special aluminum alloy. To ensure accuracy and durability, the knife edge is made of a special alloy steel and the bearing is of highly polished agate requisite to accuracy.

The Bennett Balance, because it is made by modern methods of quantity production, is now available at a price so low that it is within everyone's reach. Schools can afford to supply one to each student and save wear and tear on expensive balances, as well as the student's time in waiting his turn to use the few balances available. Industrial and hospital laboratories can place one at each point in the laboratory where weighing is done. Much time is thus saved for the technician.

Each balance is carefully calibrated and tested before shipment. To pass, it must be sensitive to 1/100th of a gram. It will weigh a maximum of 101 grams. It has been approved under Serial No. B17 by the New York City and Pennsylvania Bureaus of Standard Weights and Measures for auxiliary use in drug stores. It is now furnished in the apothecary as well as the metric system, as it is being used more and more by photographers, pharmacists, chemists, experimenters and miscellaneous workers in both science and industry.

Plastic accessories have lent additional qualities to this balance. A handsome (*Continued on page 59*)

THREE-IN-ONE

by MONTGOMERY FERAR AND CARL W. SUNDBERG
Sundberg-Ferar Industrial Designers

This new International Radio successfully combines phenolic, urea and acetate materials in one assembly

TAKING THEIR CUE FROM THE AUTOMOBILE industry, whose phenomenal success has been due to the yearly restyling for sales, the radio manufacturer too has realized the necessity of incorporating visual appeal and functional appearance into his product.

The attempts to accomplish this in wood have not been altogether happy or contemporary. Wood, for all its living beauty and acoustical properties, is not a material functionally suitable for mass production. Competitive mass production means low unit cost. The many operations necessary to wood cabinet construction, such as elaborate cutting, shaping, gluing and finishing, the susceptibility of that finish to damage in handling, is making the cost of wood cabinets prohibitive. True, wood cabinets can be cheapened by inferior construction, cheap woods and inadequate finishing, but this cheapening process is invariably reflected in the cabinet's exterior appearance and much to its detriment.

The conviction that plastic materials could have a definitely more sincere expression in radio design than has hitherto been the case, led the International Radio Corporation to pioneer with the idea of using two or three plastic materials in combination, exploiting not only the color contrasts, but also the differentiation in the quality and texture of the various materials. C. A. Verschoor, the president of this company, who was already responsible for the introduction of the first plastic radio cabinet, felt that this combination of various plastic materials was a field whose possibilities up to the present time had been unexplored by the designer.

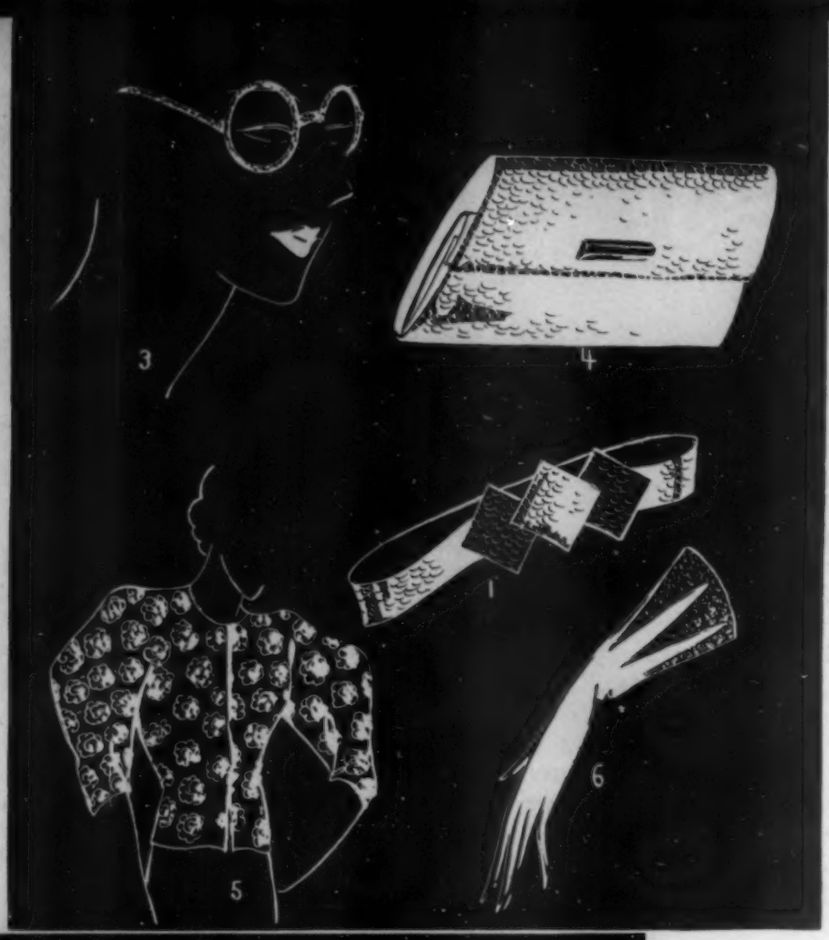
A urea top and matching grilles of acetate accentuate the glossy black of this phenolic cabinet of which front and back are equally finished and pleasing in decorative appearance

Our firm was asked to present a design solution working from this idea, which would incorporate sincerity of form, wide color range, lightness, compactness, economy and speed of production. The dominant feature of this design was to be a speaker grille motif which would fully enhance and emphasize the peculiar depth, sheen, and grain interest of the infinite number of Tenite variegations available. Strength as well as beauty led to the adoption of a cellulose acetate material for this part of the design for it is the one feature of the cabinet most vulnerable to breakage. These grilles, interchangeable front and rear to effect a savings in mold cost as well as symmetry, have a pronounced curve outward in plan to eliminate the flow marks that might occur in a straight place, to provide a certain depth and sense of structural strength in each louvre which is and gives the impression of good construction and thirdly, by virtue of this curve, to afford a broad highlight on each louvre bringing out the full luster, depth and translucency of the material. Two of the horizontal members of the grille are wider and grooved to avoid monotony; this grille is molded in one piece and held together by tie bars at each end. As the same grille appears on the back, the cabinet presents as finished an appearance from every point of view. Innumerable occasions arise in home decoration where the radio is placed so that an open back disclosing the works of the set would be decidedly objectionable from the appearance standpoint, as well as being a dust catcher.

The main body of the cabinet, in contrasting colors, of Bakelite or Plaskon, is molded from the bottom with the holes necessary for the mounting of the chassis and other parts of the cabinet molded in. The tops of Plaskon or Durez in harmony (*continued on page 55*)

PLASTIC MODES

by EVE MAIN



SHIELDS & CO.

PLASTICS ARE GOING IN FOR NIGHT LIFE IN A BIG WAY BOTH AT HOME AND ABROAD AS ACCESsories and ornaments for after-dark costumes. In Paris: (3) Glorified spectacles by Chanel have transparent plastic frames lavishly sprinkled with rhinestones. (4, 1) Worth contributes a handbag and matching belt covered with black and amber yellow cellulose spangles. (5) Patou trims a blue evening bolero with acetate plastic sequins in floral motifs of several tones of blue. (6) At the same house, gloves of black lacquered satin have cuffs covered with black cellulose spangles. (7) Chanel offers a

DU PONT

button of black plastic simulating onyx outlined with tiny rhinestones. (9) Intended for clip or buckle is this ornament from Worth, combining bright colored plastic, gold metal and rhinestones in a sphinx design. (8) Also from Worth, a dark red plastic ornament with leaf design in rhinestones. (10) Plastic plaquette with links and tassel accented by rhinestones. (2) Goupy emphasizes the vogue for plastic evening jewelry in the bracelets and belt buckle used to complement a lace evening gown. Sketches were made in Paris through the courtesy of du Pont. At home: Glittering rhinestones adorn a transparent cigaret case for evening duty. For the cocktail hour, Louisesanders suggests an open top Oriental turban, known as the "Maharajah," fashioned from rich dull black taffeta dotted with shiny black cellulose film and trimmed with a plastic wing-like ornament at the side.

EDITORIAL COMMENT

I WANT TO THANK THOSE READERS WHO SO kindly cooperated recently by returning their questionaries promptly, and to express my sincere appreciation for the friendly tone of their comments and criticisms. The response was truly amazing (more than 30%) and the indications those readers gave us of the things they want to know about plastics will enable us to build a custom-made publication during the next twelve months. Of course it is not possible in any publication to completely satisfy all readers, but with the information we have gathered we shall be able to guide our course in developing editorial material along the lines of greatest interest to the majority of our readers, and to include sufficient specialized information to appeal to everybody who reads our magazine.

To the *less than 2 per cent* of our readers who expressed their wish for increased technical information, more details about formulas, more chemical analysis, and such, let us point out this fact: MODERN PLASTICS is designed to acquaint all industry with the growth and development of plastic materials and plastic products, and to record results. Our Technical Section is planned to treat broadly upon the technical phases of this growth and development and will be expanded along the lines of expressed interest in the questionaries. To those who seek more detailed information than would be appropriate in these pages, we solicit correspondence with our Technical Editor who will gladly advise them without cost, or will refer them to sources of dependable information available to their use.

IN THE LIMITED NUMBER OF EDITORIAL PAGES at our disposal each month we shall continue to dispense dependable information about new materials and old, without prejudice or bias. We shall present new methods and equipment and indicate their importance to our readers in general. We shall try to illustrate each new application worthy of attention and invite our readers to cooperate by submitting their products for editorial comment. We invite reader correspondence regarding sources of materials or services of any kind. We may not know all the answers but we shall at least make a sincere and conscientious effort to find them for you and shall consider it a privilege to have the opportunity to be helpful in any way.

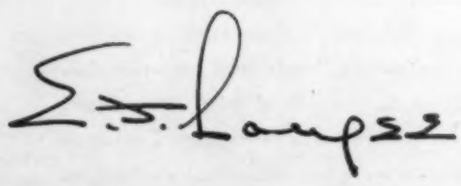
We are entering a New Year in which courage and faith have cut a broad path for opportunity. There is every evidence of progress and prosperity ahead. In a broadcast recently sponsored by a group of American banks, Bruce Barton declared that, due to present-day advertising efficiency and mass production, it is no longer necessary to wait a generation for the benefits to be derived from services and conveniences such as the sewing machine, mechanical refrigeration and the radio.

"When you see an increase in the volume of advertising, either in newspapers and magazines or on the billboards or over the air, you may regard it as a good sign. For it means that the purchasing power of the common people is larger," he said.

THE CHRISTMAS SEASON JUST PASSED IS PERhaps one of the best indications of the present state of the American mind and of American industry, and defines the substantial recovery this country has attained. Retail sales climbed to new heights. Shipping and mailing of gifts and cards passed the ceiling of 1929. Transportation was pressed to capacity. Contrast this with the black Christmas of a few years back, followed by those of brown and gray with their suffering and want—their hesitancy and uncertainty, and you have a pretty good picture of today. Christmas just passed reflected the brilliant reds and greens of the holly and lighted trees which are its symbol.

It was during those dull, dark years that the plastics industry proved its importance and forged ahead to the place of its present occupancy. It was during this same period that those in research made their greatest progress and emerged with invaluable contributions of materials and methods. But it is NOW and in the future that all industry will grasp the potential merits of these new man-made materials and make the most of them. It is NOW and in the future that those entrusted with production will be eager to discover these merits and become acquainted with their properties and possibilities.

IT WAS DURING THESE SAME DULL, DARK years that MODERN PLASTICS brought an enthusiastic interpretive publication into the field. But it is NOW and in the future that this publication can render its greatest service to its readers and its advertisers by building on the custom-made plan so clearly outlined by those readers who cooperated with the questionary.



Stock molds

SHEET TWENTY-FIVE

Plastic boxes are available from stock molds in various shapes and sizes. Some are plain, some are decorated and some are novelty items. Be sure to mention both the sheet and item number and to write on company letterhead when requesting samples

120. Vertical drum box with molded foot and handle. 3 11/16 in. diameter. 4 5/16 in. overall height. Width inside, 2 13/16 inch

121. Hinged box with small bordered square in upper left corner, otherwise plain. 3 15/16 in. long by 2 13/16 in. wide by 7/8 in. deep inside. 1 7/16 in. overall height

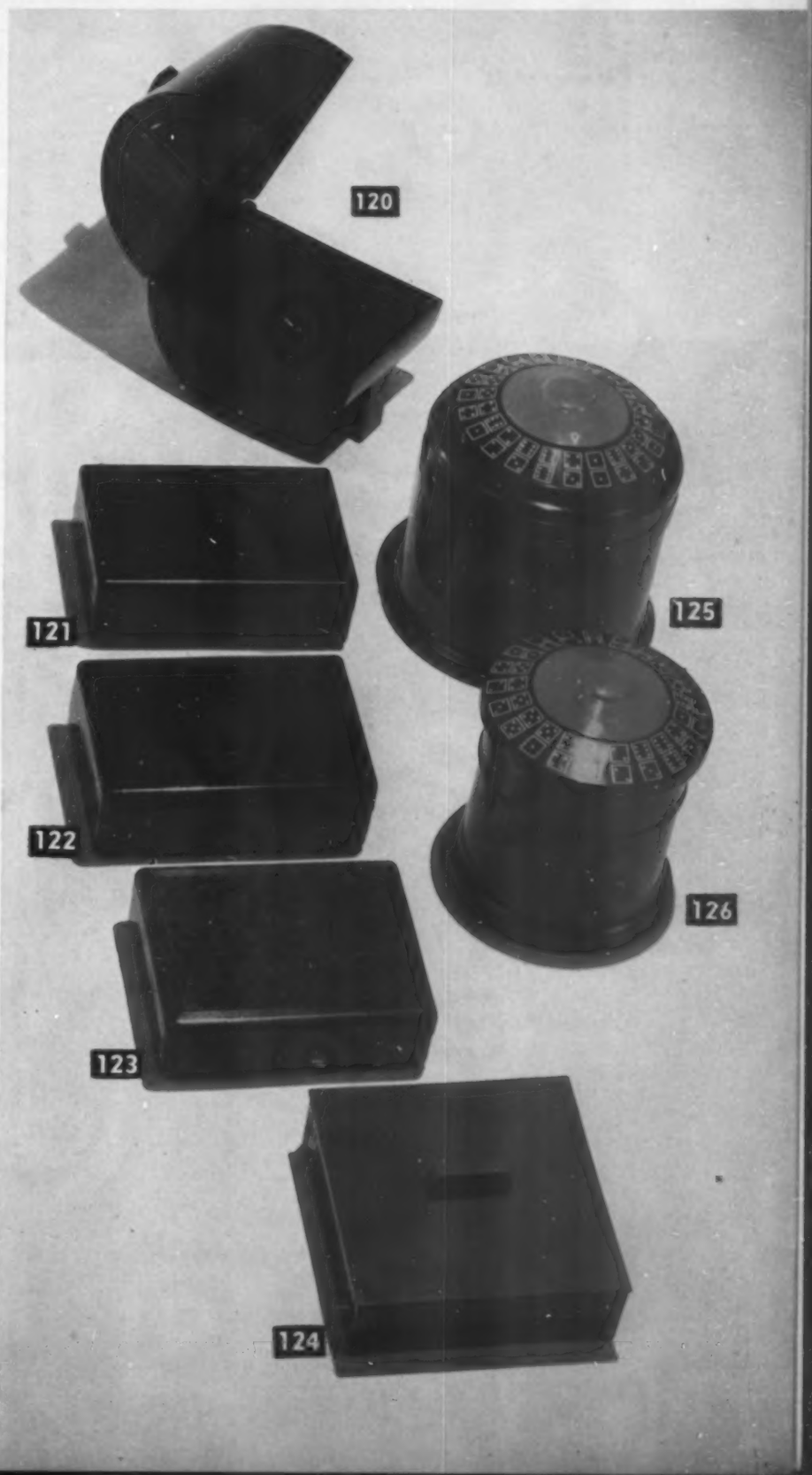
122. Hinged box with designed cover and trade-marked bottom which may be removed. About 3 15/16 in. long by 2 3/4 in. wide. 7/8 in. deep inside and 1 1/2 in. high overall

123. Box with grooved border on lift-off cover. 3 11/16 in. long by 2 15/16 in. wide by 13/16 in. inside depth. Overall height is 1 1/8 inch

124. Flat box 3 7/16 in. square, and separate lid with molded handle. Inside depth of box is 13/16 in. Overall height, 1 7/16 inch

125. Unique cigaret box with roulette wheel mounted on a bearing that allows easy spinning. Diameter 3 7/8 in. Height inside, 2 1/16 in. Overall 4 3/8 inch

126. Smaller version of the roulette wheel cigaret box. 2 13/16 in. diameter. 2 3/16 in. high inside. 3 15/16 in. overall

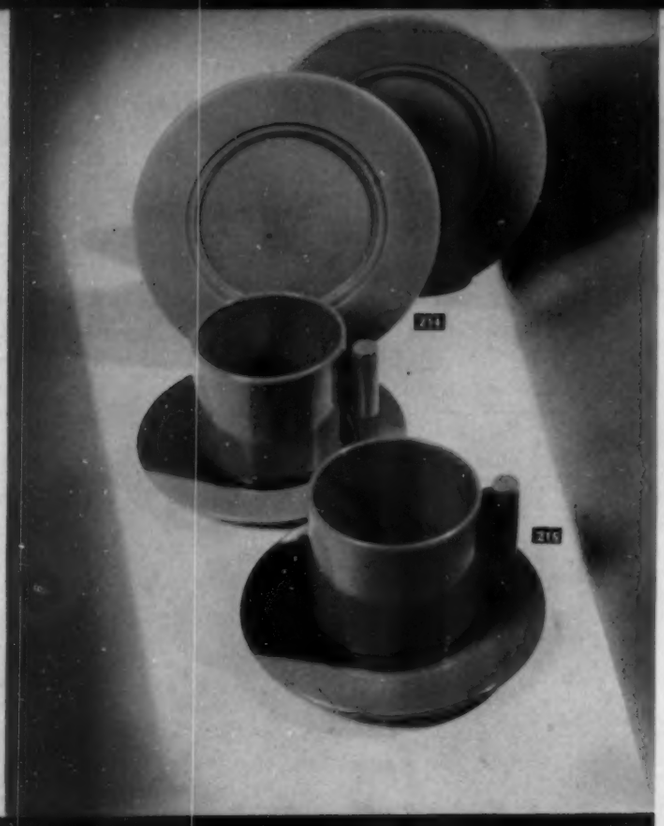


Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits.

Stock molds

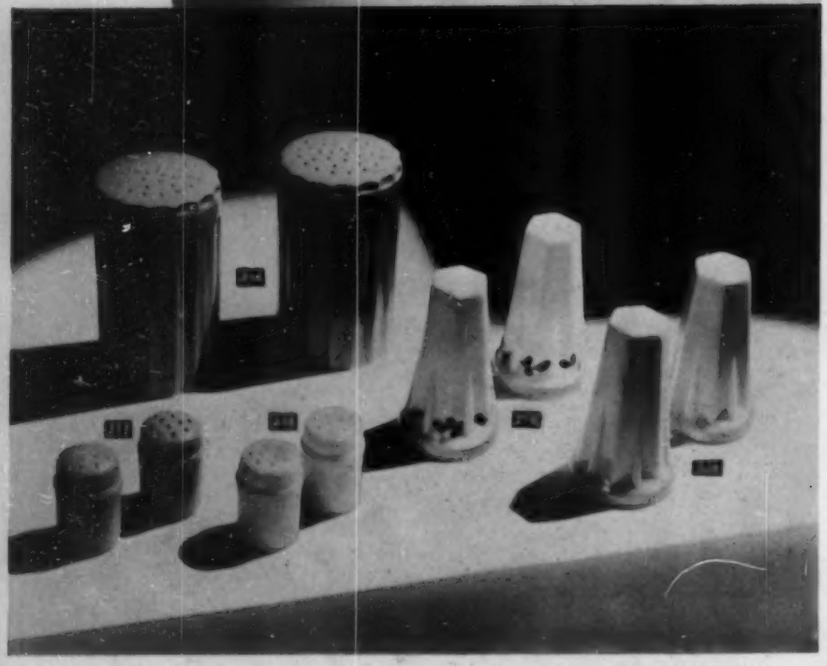
SHEET TWENTY-SIX

Here is a group of molded pepper and salt shakers which come in various sizes and shapes. They make swell premium and household numbers. Also tea sets for children



211, 212, 213. Child's tea set, composed of teapot, sugar and creamer in gay colors. Head of Alice of Wonderland in contrasting colors

214. Miniature molded plates 4 5/16 in. in diameter. Available in various colors. **215.** Small cups and saucers to match plates. Cup 1 7/8 in. in diameter by 1 13/16 in. high. Saucer is 3 5/8 in. in diameter



216. Pepper and salt, with identification molded on closure which has scalloped edge. Fluted sides 3 1/4 in. overall and diameter 1 5/8 in. Good kitchen size

217, 218. Individual peppers and salts with knurled sides, 9/16 in. in diameter and 1 3/8 in. high. In various colors

219. Hand decorated set 1 5/16 in. diameter and 2 3/4 in. overall. Ivory with green

220. Same as 219 but undecorated. Screw base for refilling

Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits.

CLEAR AS CRYSTAL

Flute and violin are machined and fabricated from one of the new transparent resins recently made available in this country. Photographs, courtesy Rohm & Haas

THESE MUSICAL INSTRUMENTS OF TRANSPARent plastic are perhaps more novel than they are practical and were made in Germany to demonstrate the fact that this material can be fabricated with exceedingly delicate accuracy when required. The flute is said to have splendid tonal qualities and is entirely suitable for concert purposes.

The violin has a rich tone unmatched by many such instruments made of wood but is rather weak in volume. It is reported that one of the newsreels is circulating a film showing the violin and illustrating the sensitive softness of its tone. Both instruments were made from sheets, rods, and blocks of Plexiglas which were carefully machined and fitted, then cemented together as though they were made of wood.

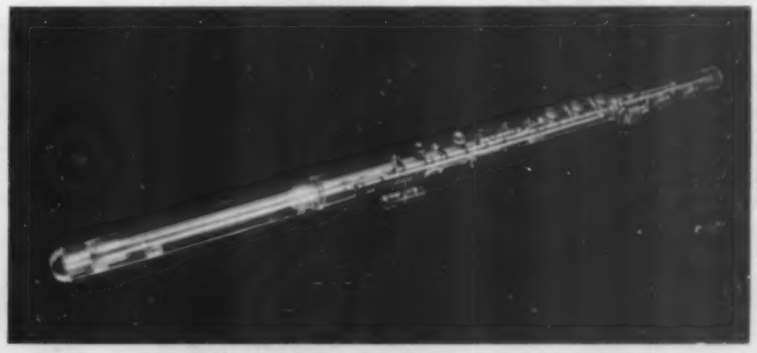
There is no indication that such instruments will be manufactured on a production basis but if Hollywood ever sets eyes on these rare examples there is no telling when we shall see some famous orchestra "swing it" with complete transparent equipment. The bass horn may have to be omitted for obvious reasons.

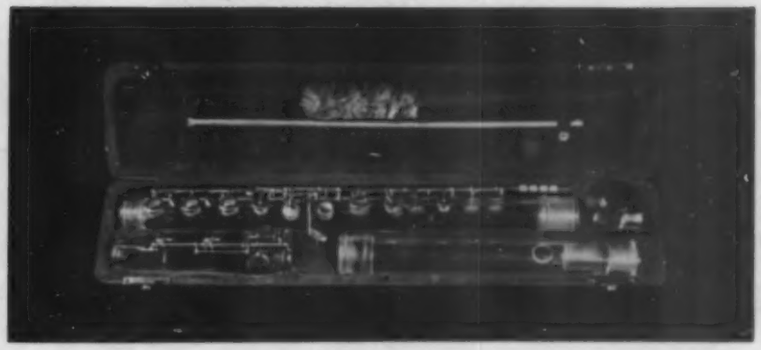
Departures of this sort from the every day uses of plastics are always interesting. They indicate imaginative and creative phenomena which will project them into new and untried opportunities. And they are particularly appropriate at this time when new transparent resins of greater stability are being made available in this country to the molding and fabricating industries for experimentation.

There is no doubt that these new materials will be employed very soon in many practical ways. Designers will welcome such transparency when they realize the material is clear as crystal, yet one-third its weight. The mere fact that it can be both machined and molded, according to the particular application, removes restrictions of form that would be difficult to overcome with glass. The materials are capable of injection molding which means rapid and comparatively inexpensive production that will in a measure level off the price differential and permit their use in competitive fields.

For extended production of intricate forms, molding will be the more practical method of fabrication, but since these materials are also available in various shapes such as rods, tubes, sheets (*Continued on page 54*)

These musical instruments were made primarily to demonstrate the transparency of acrylic resin and indicate its possibilities for fabrication. They are practical, however, for concert purposes





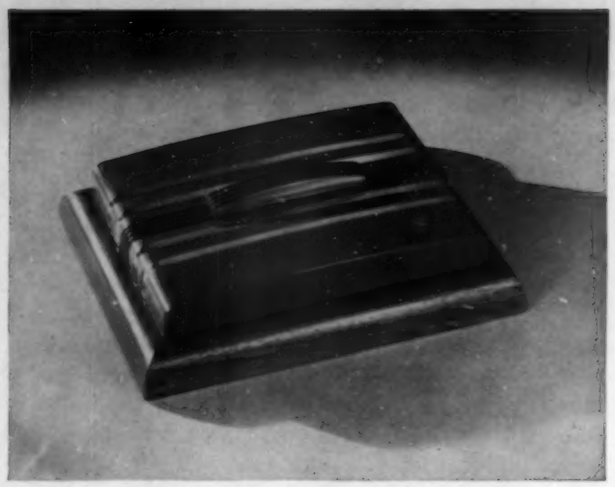
PLASKON

MOLDED COLOR

LIGHT-UP VANITY:

"She shall have beauty wherever she goes" is the big idea behind this portable light-up vanity, which can be connected to any boudoir, state room, or hotel outlet. And do the ladies like the idea! Being exactly what its name implies, the new vanity has a mirror on the inside of the cover as large as the cover itself; a light, hidden by a sheet of translucent Plaskon, that reflects the light on the face to aid in careful make-up; and a compartment to hold puff, lipstick, and powder enough to last a campaign.

As with so many metals and plastics combinations distributed by Chase Brass & Copper, the cover of the vanity is polished chronium and the box is beautiful and durable ivory Molded Color. Plastic Molding Company of Sandy Hook, Connecticut is the molder.



MANICURE SET:

We risk our reputation about twice a year in these columns by making prediction on the future course of modern packaging. The minute we saw the Sarane Streamliner Manicure Set we knew that half our prediction quota for 1937 would be spent to say that a combination of Plaskon and wood and metal will be used for a lot of packages.

The idea of combining the materials is an entirely new packaging conception (so far as we know), and was original with Mr. L. Z. Kramer of M. V. C. Laboratories of Toledo, Ohio, who thought it up for the manicure preparation trade. Mr. Kramer promptly commissioned Van Doren & Rideout to design a package incorporating his idea. The Sarane box was the happy result.

The Sarane box is made of smooth mahogany and has a dark green permanent-color Plaskon cover which is inlaid with chromium strips. It is a sturdy container and is inexpensive to make. The most important fact upon which we pin our prediction, however, is the unusually rich and distinctive appearance the new box presents.

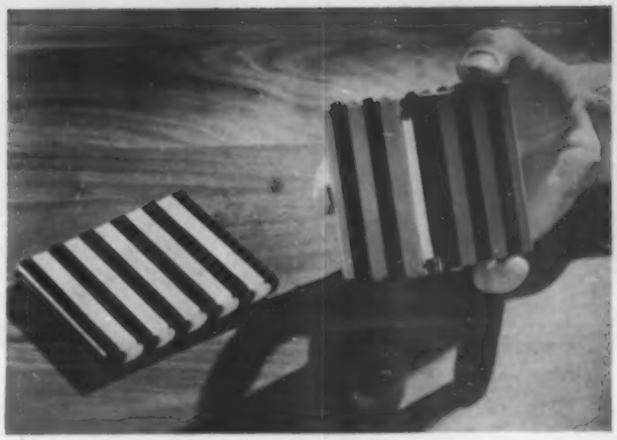
JANUARY 1937

DOMELIGHT LENSES:

The dome light lenses on the General Motors family of cars is an important 1937 application of Plaskon, symbolizing the preference of automotive manufacturers for Molded Color. In contrast with glass lenses, the decorative beauty and permanent lustrous finish of the new lenses are achieved without finishing operations of any kind. The added safeguard of the non-shatterable, translucent Plaskon lenses—which furnish soft uniform light—are other advantages not lost on a safety-conscious motordom.

The General Motors lenses are being molded by the American Insulator Company of New Freedom, Pa., and Chicago Molded Products, Inc. of Chicago.

Characteristically, Plaskon has found wide automotive application since that time, several years ago, when it was used to make the first translucent dials for instrument boards. Watch these pages for pictures of Molded Color handles, controls, horn buttons and lighting switch assemblies on 1937 cars.



CIGARETTE CASE:

In this day of combination automatic cigarette cases and lighters which do everything but keep the ashes from spilling on your vest in the good old-fashioned way, the Krischer cigarette case gives us quite a start. It seems that its sole function is providing a convenient means of carrying about neatly-rolled cigarettes. The thousands of people who have bought them simply "break open" the case to free a gasper from an individual compartment.

The Krischer people say that eye-catching Plaskon color combinations and the finish on the cases have helped immeasurably in making the item a success. Also that the great variety of Plaskon colors has enabled them to make the case in many sure-fire color combinations. Molded by Accurate Molding Company, Brooklyn, New York.

This month we enter a new year—our third—in these pages. We want to use them in the way most valuable and interesting to you, in 1937. If we're omitting some things you'd like to see, please let us know.

PLASKON COMPANY
INCORPORATED

PLASTICS' PROGRESS

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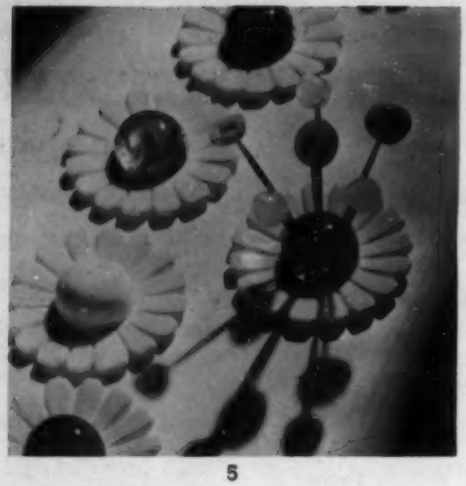

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1. Time Meter is an electric precision-built household instrument which combines the usefulness of a clock with time measurement and a warning buzzer. The case is molded in black or white

2. The Sonotone Power Booster has been redesigned and now uses a molded Bakelite housing. This compact amplifying unit can be plugged into any electrical outlet, eliminating the use of batteries

3. Fiberlon makes a glistening base for the Robinson Pen-in-Ink set which has a reservoir keeping the pen point always in the ink. The base is available in onyx, jade, mottled brown or black

4. A convenient way to use hand lotion is furnished by the Jergens Smooth Flow Tap. Molded of plastics, it fits snugly on the bottle and releases the lotion when the plunger draws it to the top

5. A novel item for the buffet is this individual Sunflower canape holder, carved of Catalin by the Quality Turning Co. It has six small holes in the center for toothpicks to hold the canapes or olives and cherries

6. A portion of the horn buttons and lighting switches on Ford cars are being made of Plaskon, and molded at the Ford Company plant. Plastics do not fade and are most suitable, they claim

7. This Pilot light gives a faint glow which is directed downward by a small overhanging shade. It enables one to locate the switch button at any time. Shade and switch are molded of Bakelite for Utility and Novelty Mfg. Co.

8. An elbow molded of Neillite by the Watertown Mfg. Co. for the Bridgeport Thermostat Co. is used in connection with a device that sucks oil from a crank case by means of a vacuum

9. Handles of Bakelite molded, tipped with polished virgin aluminum are made for the A. & J. Kitchen Tool Co. The permanent finish is an integral part of the handle and it will not chip

10. The Schelter Last Co. introduces a shoe tree with a Durez handle molded by the Reynolds Spring Co. The bottom portion of the handle contains a coiled spring and the tree snaps into place when the handle is pushed down

11. A light weight hair clipper in which two intricate molded Durez sections form the entire housing, motor support and blade assembly, has a removable clipper head. Molded by Chicago Molded Products Corp.

12. These novelty flash-lights called Jewelites are being distributed by the Usona Mfg. Co. They are made of metal with perforated Plaskon molded caps supplied by the Owens Illinois Co.

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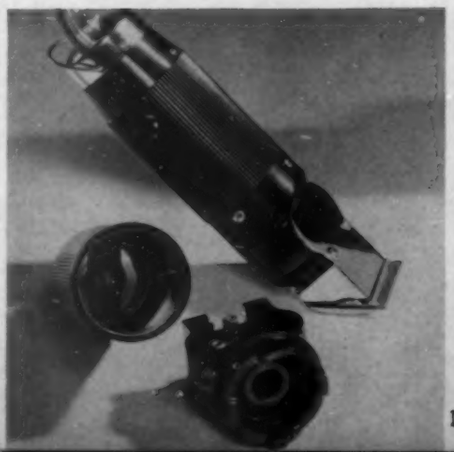

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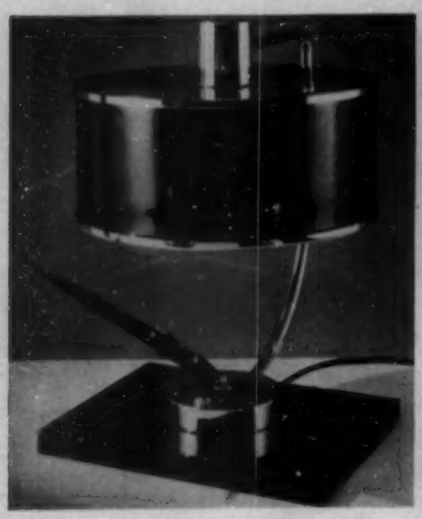
CREATING DESK SETS THAT SELL

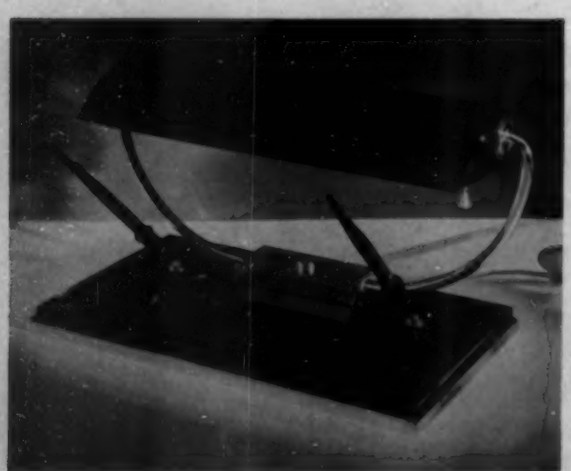
We asked Thomas Tibbs, industrial designer, why he used plastics in his designs for Sheaffer Desk Sets. We knew there were good reasons, and here they are

by JEAN MILLER



THOMAS TIBBS HAS BEEN DESIGNING FOR INdustry for ten years. Some of his most recent and excellent work has been for the Sheaffer Pen Company. He says he finds a world of new concepts and extensive means for expression in working with the new, contemporary plastic materials. Greater understanding of these materials by manufacturers will result in their more frequent use and in his opinion there will eventually be little, if any limit to their decorative application.

Designers, working in cooperation with the manufacturers of these materials have developed new and valuable treatments which promise even greater range of application and decorative effect. The advantages of plastics, according to Mr. Tibbs, are more and more apparent over the more familiar materials and in many cases where technical requirements become important factors, the use of plastics is almost indispensable. He emphasized this point by calling attention to the fact that the development of highly specialized products in which metal as well as plastics are combined in the same unit, is not only a problem of design but a complicated, technical development requiring the utmost patience and coordination of the agencies concerned.



He went on to say that he found this particularly true when he was engaged by the Sheaffer Pen Company to "dress up" their pens to create interest and stimulate sales. One of the problems, desk sets with pens and bases, and some sets with lamps, to match, he found both interesting and unusual.

This problem was met by working out designs with the more modern plastic materials and for the first time these various combination desk sets made their appearance in this new dress and immediately gained acceptance.

Bakelite resinoid, a cast *(Continued on page 54)*

TECHNICAL SECTION

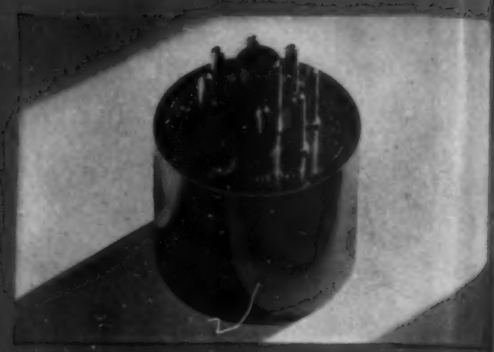
MODERN PLASTICS

MARTIN BOMBER—SEE PAGE 55

COOL

Molded by International Insulation Division of General Industries Co., Elyria, Ohio

Says Samson United Corp. of their modern electric iron: "It is much easier to use . . . even for long periods of steady ironing . . . because of its oversize, fatigue proof, air cooled handle. This handle guards against burns by providing an ideally cool back-rest for the iron." The new Samson United Iron has had a phenomenal sales record. That Durite has been selected as the ideal plastic for the handle of the Samson United Iron is evidence of its worth, but this is only one of thousands of applications where Durite has been the specified choice of leading companies for many years. If you have never had occasion to learn of their advantages, write and ask about these unusual plastics by Durite, the exclusive producers of phenol-furfural resins.



Radio Tube Base of Durite

A FEW REASONS WHY DURITE WAS CHOSEN FOR THIS IRON HANDLE

1. *Durite has all the properties of high plasticity, fast cure, smooth finish, and uniform shrinkage needed in the material for the rapid, large scale, trouble-free molding of such complicated parts.*

2. *Production finishing and assembly costs are kept down with mounting lugs or inserts molded in. Durite parts are completely formed, trimmed, and made ready for final assembly in but three operations. Each is an exact duplicate of the next.*

3. *The glossy gleaming finish of Durite makes an invaluable sales appeal. In a rich deep black contrasting with the sheen of chromium plate Durite adds striking beauty to an assembly, and beauty creates sales.*

4. *The Durite finish is permanent. No amount of handling can cause it to crack, peel, wear, or chip off.*

5. *Durite parts of proper design can be light in weight yet of surprising strength, capable of taking much abuse from careless handling.*

6. *Durite transmits heat slowly, and its texture hot or cold is pleasant to the touch. It is also unaffected by moisture, oils, alcohol and other common solvents.*

Electrical Distributor Head of Durite

DURITE *Plastics*

TRADE MARK REG.

Frankford Station P. O., Philadelphia, Pa.

A DIVISION OF STOKES & SMITH COMPANY

METHODS OF TESTING PLASTICS

by G. M. KLINE AND B. M. AXILROD
National Bureau of Standards

Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce. This paper was presented as part of a Plastics Symposium at the Pittsburgh meeting of the American Chemical Society and was published in Industrial and Engineering Chemistry, volume 28, pages 1170–3, 1936.

1

Fig. 1—Martin bomber showing transparent plastic covering turret and cockpit

THE CLARITY AND SCRATCH RESISTANCE OF transparent plastics are of prime importance in connection with their use as windshields on aircraft (Figure 1). In a study[1] of these materials now under way at the National Bureau of Standards in cooperation with the National Advisory Committee for Aeronautics, special methods were developed for the measurement of these properties. These methods and some of the test results obtained on various plastics are presented in this paper. In order to show the relationship between the scratch resistance and the more familiar indentation hardness, data on this latter property are also included.

Clarity of plastics

The clarity of plastics is generally considered as dependent upon two factors, transmission and scattering of light by particles or by surface imperfections. The military services generally specify that the plastic sheet shall transmit at least 68 per cent of white light when tested within 30 days of date of manufacture and shall be free from wrinkles, bubbles, scratches, pits, or depressions. The light transmission is usually measured with a visual or photoelectric photometer, in the latter case with a photoelectric cell which is sensitive mainly to the visible portion of the spectrum. The transparent plastics now in use generally transmit more than 85 per cent of the incident light. The haziness has been measured by several methods, including visual inspection with or without a background of light from Cooper-Hewitt lamps, comparison of the plastic sheet with samples of varying degrees of haziness, attempts to count the "star dust" visible in a small area under the microscope, and determination of a small portion of the light scattered when the sample is placed at a suitable angle with relation to the light source and photometer. This latter method, although having the desirable feature of utilizing one instrument for measuring both light transmission and haziness, presents some difficulty because of the possibility of introducing considerable error in measuring only a small portion of the scattered light.

A photometer of simple construction, hereafter called the hazeometer, which can be used effectively to measure the haziness of a plastic as well as the light transmission, was developed in the course of investigation.

Description of the hazeometer

A photograph of the photometer (built for us by Mr. E. E. Bowen, Bethesda, Maryland), is shown in Figure 2. A 6-volt automobile type bulb is mounted in front of a reflector. A cylindrical shield blackened inside and with a circular aperture, *b*, in the center of the base, causes an approximately parallel beam of light to be radiated toward the photocell. A blackened disc with a circular aperture, *a*, is mounted in front of the photocell. In the instrument as built for experimental purposes the two openings, *a* and *b*, are each one inch in

Fig. 2—Hazeometer

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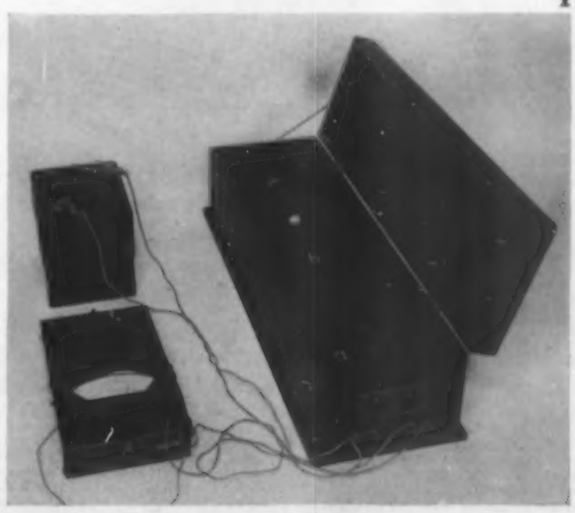

diameter and are spaced 18 inches apart. The photocell is of the Weston photronic type.* The meter used has an internal resistance of 50 ohms and a range of 100 microamperes. Spring clamps were fastened to the frame at each aperture to hold the plastic in place. A 6-volt storage battery was used to operate the lamp. All the parts were housed within a wooden box finished in a dull black which reduced reflections to a minimum. The lid of the box was closed during measurements to keep rays of light from outside sources from reaching the photocell.

Test procedure and definitions

To obtain a measure of the light transmission of the plastic, the light is adjusted in intensity so that a current of 100 microamperes is obtained from the photocell. A flat sample is then placed in front of the photocell at aperture *a*. Of the light incident on the sample, a fraction is transmitted undeviated and a fraction is scattered by the surfaces and the interior of the sample. The photocell will receive the undeviated fraction of the light and that part of the scattered light which is not deflected at angles greater than about 90 deg. The light transmission of the plastic is defined as the fraction of

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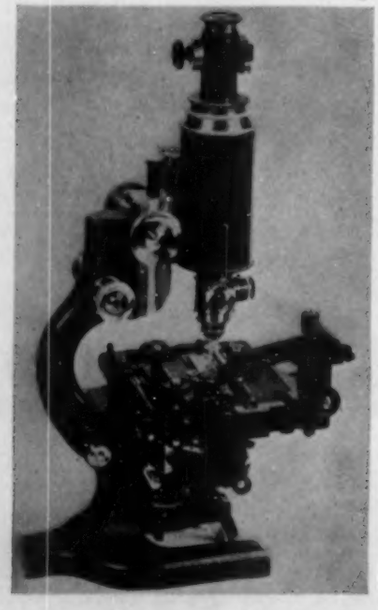

the original light received by the photocell which continues to reach the sensitive element when the plastic is placed over the aperture (*a*) at the photocell.

To obtain a measure of the haziness of the plastic the sample is placed at aperture *b*, 18 inches distant from aperture *a*. The photocell will still receive the undeviated fraction of the light, but will collect only that small portion of the scattered light which is confined to the small solid angles subtended by the aperture *a* at points in the opening *b*. The difference between the photoelectric current with the sample at *a* and at *b* is a measure of the light scattered, assuming that a linear relationship exists between the photo current and the total light incident upon the sensitive element of the cell. The current is practically proportional to the total incident light for no external resistance; the deviation is only slight for the 50 ohms resistance in the microammeter used. Haziness is defined as the percentage of the total light transmitted at position (*a*) which is scattered when the sample is placed at position (*b*).

Results

Some results obtained in tests of cellulose acetate plastics with the hazeometer are shown in Table I. It will be noted that the light transmission (column A) of the samples containing blue dye is in all cases less than the materials free from dye. Because of this pronounced effect on light transmission, the practice of adding blue dye to cellulose acetate transparent sheet has been discontinued by some manufacturers. For undyed materials approaching the transparency of polished glass, most of the loss is due to reflection at the two surfaces and can be calculated from the refractive index.

It might appear that the relative haziness of a sample could be judged by merely noting the difference between the light transmission at positions *a* and *b* in the hazeometer (column A-B). However, the haziness in a material which has a very low light transmission cannot be judged in this manner. Sample 9 which contained a large amount of blue dye illustrates the difficulty encountered. It is, therefore, necessary to base the haziness on the percentage of the transmitted light which does not reach the photronic element when the sample is at position *b*. It was found that the relative order of clarity of the samples as determined by visual inspection by several individuals was essentially the same as indicated by the haze values in the table. If it is desired to separate the effect of surface defects from

Fig. 3—Bierbaum scratch resistance apparatus. Diamond tool (above) in scratching position. Diamond tool (below) swung aside and microscope in position to measure scratch width

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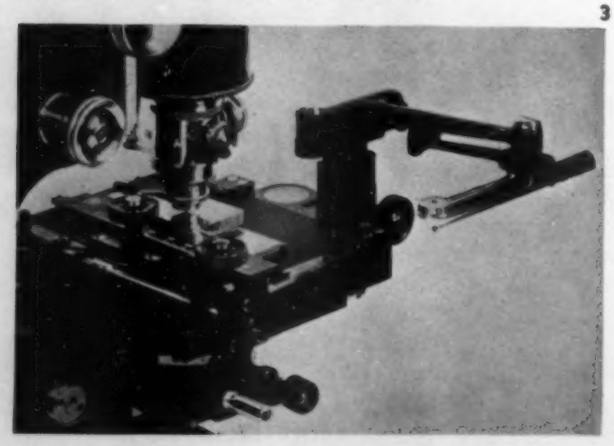

*The spectral response of this cell deviates considerably from the luminosity curve of the eye and hence the light transmission obtained is not the same as would be measured with a visual photometer, but is a close approximation to such value for samples with little or no dye. A filter can be obtained from the manufacturer which will approximately correct the response of the cell to visible light

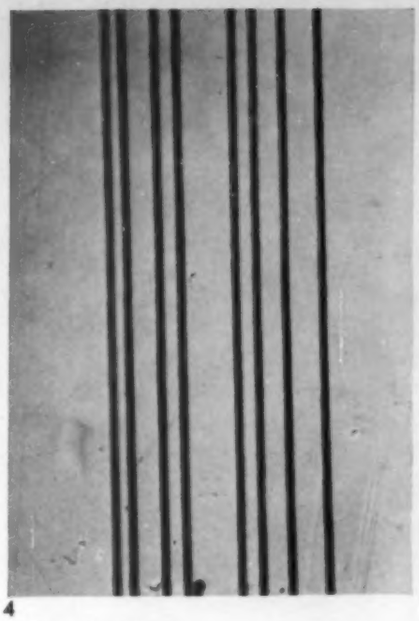

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Fig. 4—Scratches on cellulose acetate plastic

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Fig. 5—Vickers Hardness testing machine

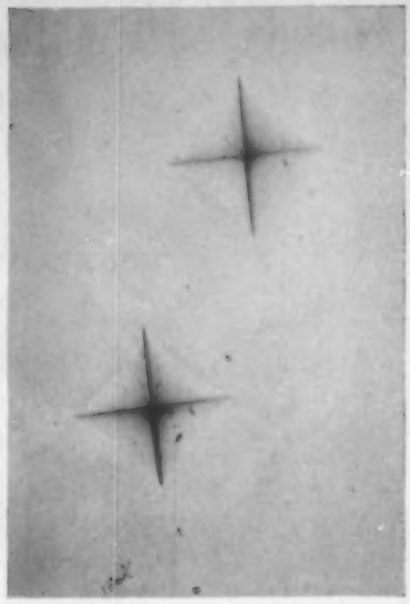

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Fig. 6—Pyramidal indentations on vinyl resin plastic

haze in the interior of the sheet, this can be accomplished by wetting the sample with a liquid having a refractive index approximately the same as the plastic.

Scratch resistance of plastics

The comparative ease with which transparent organic plastics are scratched is a major obstacle to their substitution for glass in many applications where their toughness and non-splintering characteristics would be advantageous. However, the plastics vary considerably among themselves in scratch resistance and it is desirable to have a method of measuring this property. The effect of tumbling with sand of a standard grade was tried, but it was found that after a short period a polishing action produced by fine fragments tended to undo the action of the coarse grains of sand. It was also found to be very difficult to remove the fine dust from the samples preparatory to determining the amount of abrasion by measuring the light transmission of the abraded materials.

These difficulties are avoided by the use of a sklerometer to produce a band of scratches on the sample, from which the relative resistance of the material can be judged by determination of the average width of the scratches. Various types of sklerometers have been developed for use in making scratch tests on metals. These have been discussed in detail by O'Neill.[7]

Description of apparatus

The instrument used in our work on plastics was developed by Bierbaum[1] and is known as the "Microcharacter" (Figure 3). *(Continued on page 61)*

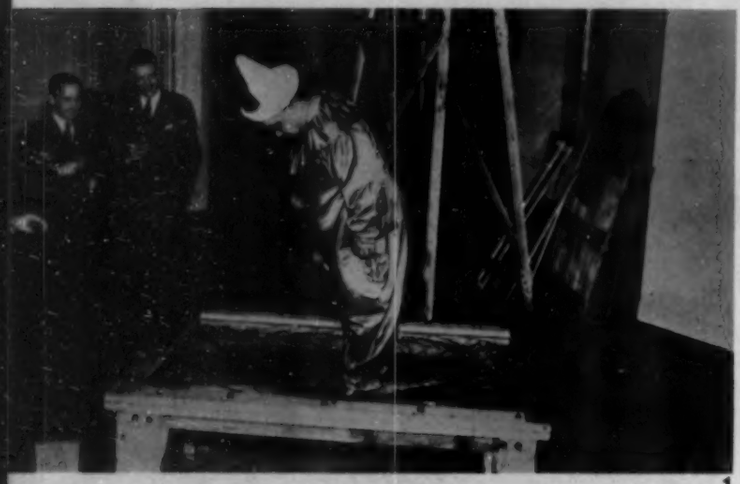
TABLE I.—LIGHT TRANSMISSION AND HAZINESS VALUES OF TRANSPARENT CELLULOSE ACETATE PLASTICS

Sample number	Thickness	Dye	Light transmission		Difference	Haziness value $\frac{A-B}{A} 100$
			Sample at photocell	Sample 18 in. from photocell		
			(A)	(B)	A-B	
	mils		%	%		%
13	53	Blue	86.3	83.9	2.4	2.8
14	53	Blue	86.2	83.7	2.5	2.9
8	67	None	90.7	87.6	3.1	3.4
17	68	None	91.2	87.5	3.7	4.1
10	65	None	91.0	85.8	5.2	5.7
2	67	None	90.7	85.3	5.4	6.0
1	67	None	90.7	85.2	5.5	6.1
5	85	None	89.7	84.0	5.7	6.4
9	31	Blue	4.2	3.83	0.37	8.8
15	35	Blue	86.7	78.4	8.3	9.6
16	35	Blue	86.7	77.6	9.1	10.5
3	105	Blue	75.0	64.3	10.7	14.3
4	105	Blue	75.1	63.8	11.3	15.0

LAMINATED SAFETY GLASS

by **ORVILLE N. GREENE**
Assistant Examiner, United States Patent Office

A resume of the development of safety glass in this country including the patent situation during the past thirty years and a prediction of future expectancy



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ON SEPTEMBER 4, 1936, LAMINATED SAFETY glass celebrated its thirtieth birthday in this country. On that day, thirty years ago, John Crew Wood[1] was granted the first United States patent on laminated safety glass. The industry languished for nine years, partly because the public of that day was slow to accept laminated safety glass. To the driver of a twelve mile an hour automobile, the danger of flying broken glass was not as obvious as it is to the man who drives the eighty mile an hour car of today. The demand was, therefore, quite limited. But the development of the industry was slow, not only because of the limited demand but also because a satisfactory sheet of laminated glass could not be made. Wood failed to recognize that his problem was one of molding and not simply of pasting sheets of glass and plastic material together. The union he formed by slightly pressing an assembly of two sheets of glass and an intermediate sheet of cellulose nitrate coated with Canada balsam was weak and temporary.

The first great advance in the art came when Edouard Benedictus[2] on February 9, 1915, received a patent on a method of producing laminated glass in which he softened a cellulose nitrate sheet and by means of heat and pressure molded it between glass plates. Using a very thin layer of gelatine adhesive on the glass to secure better adherence, Benedictus produced a successful laminated glass. From that day to the present, although the adhesives and plastic materials have been changed and improved, the fundamental concept of molding a plastic between and to glass plates to produce laminated glass has remained the same.

A clear survey of the development of laminated glass up to the present day can best be made by taking each of the elements of the assembly and tracing its history in this art from its early beginning.

4

TENITE
STEERING WHEELS

have been adopted by the automobile industry because they are colórful, shock-resistant, warm to the touch, and free from exudations that soil hands or gloves. Steering wheels are one of many products which have been improved in appearance, strength, and cleanliness by designing them of Tenite molded over metal cores. Write for a 52-page book on Tenite and its uses.

TENNESSEE EASTMAN CORPORATION *(Subsidiary of Eastman Kodak Co.),* **KINGSPORT, TENN.**

The methods of laminating

From the time of Benedictus, until about five years ago, the following was the universal practice in making laminated glass. Two sheets of eighth inch plate glass were carefully cleaned and then coated with a very thin layer of adhesive. The coated plates were carefully dried in an oven to drive off the volatile carrier of the adhesive. The sheet of cellulose nitrate, made by slicing a large block into sheets on a slicing machine, was inserted between the two coated plates and the assembly placed in a hydraulic platen press. Heat to soften the plastic was supplied to the platens and a high degree of pressure applied to mold the cellulose nitrate intimately to the coated plates. Usually a solvent was applied to soften the plastic before the pressing operation. But the rigid platens broke many glass plates during the pressing, marred others and almost always squeezed out the plastic material at the edges.

In 1930, a revolutionary method of pressing was introduced by Sherts and Hamil.[3] According to their method the assembly of glass and cellulose nitrate is given a light preliminary pressing, just enough to get a good joint. The sandwich of glass and plastic is then placed in a bath of fluid such as diethylene glycol with direct contact between the sandwich and the fluid. Pressure is applied to the fluid and transmitted thereby to the sandwich. A completely uniform pressure is obtained with no possibility of breaking or marring the glass. No squeeze-out of the plastic is possible, it being uniformly pressed by the fluid. Most laminated glass is now produced by this method.

The process when a single layer of a resin is used may be entirely different. In that case, the resin is flowed out of a hopper onto the glass plate to the desired thickness. Any volatile carrier present is evaporated off and another sheet of glass which may or may not be similarly coated is applied thereto under light pressure. With the easily moldable resins used little pressure is needed.

The plastic

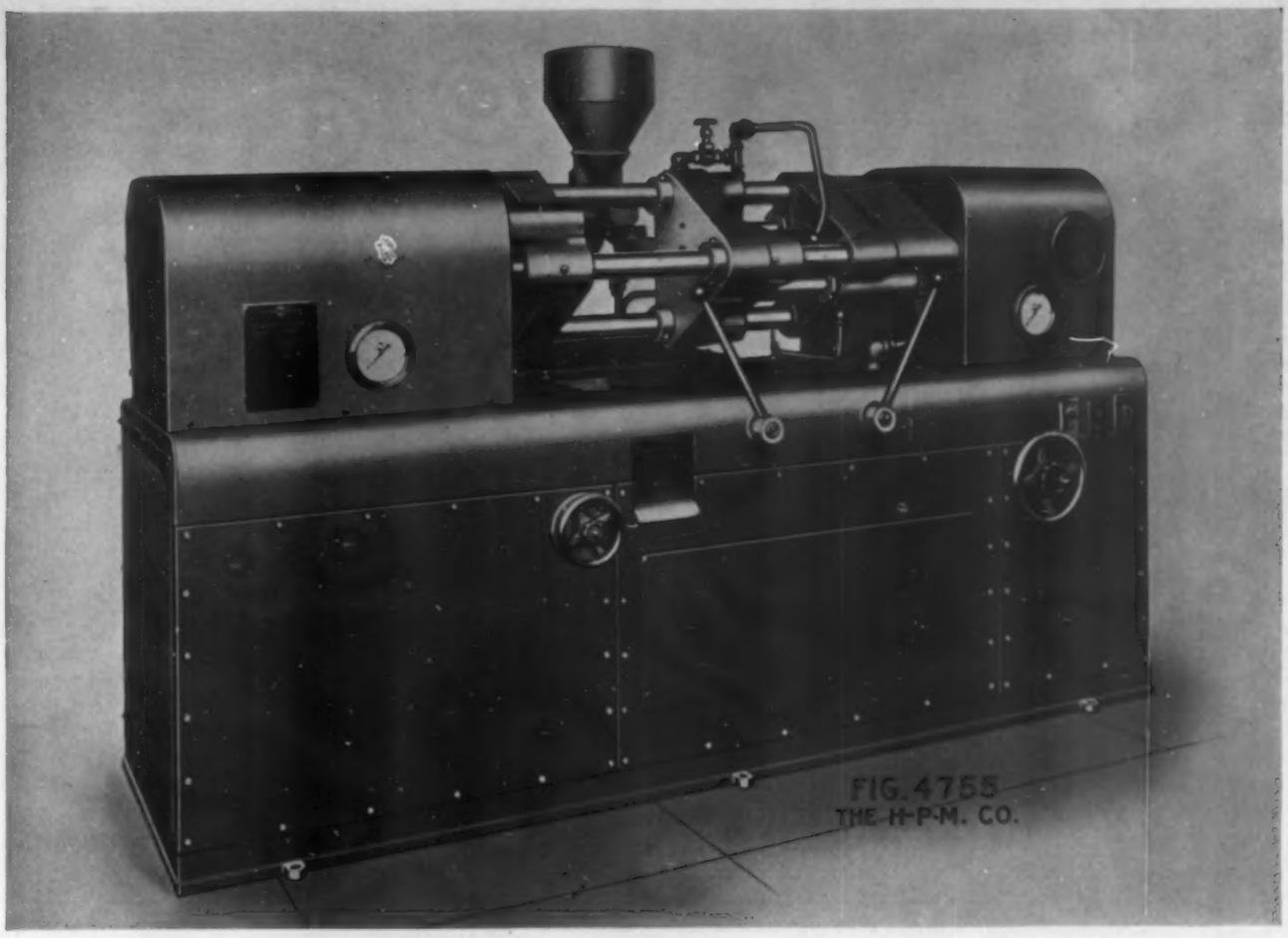
A mix of cellulose nitrate and camphor was the original plastic interlayer used by both Wood and Benedictus. The two outstanding weak points in the use of a cellulose nitrate interlayer were its discoloration and weakening after exposure to the ultraviolet rays of the sun for a relatively short time and its lack of plasticity at low temperature ranges. The first difficulty was overcome to a great extent by using a special glass[4] with an ultraviolet ray cut-off obtained by the incorporation of about 1 per cent iron oxide in the glass batch. The second difficulty, brittleness at low temperatures, was never solved.

Until about three years ago practically all laminated glass was made with a cellulose nitrate interlayer. Since then, the industry has largely turned to cellulose acetate. Besides being more resistant to ultraviolet light, cellulose acetate has the important characteristic of possessing a much higher point of decomposition than cellulose nitrate. Because of this, it can be molded at higher temperatures so that a more intimate contact with the glass is achieved. But cellulose acetate, like cellulose nitrate, loses a great deal of its plasticity and shockproof character at temperatures below about 40 degrees F. and at extremely low temperatures has little or no utility in shatterproof glass. It is for this reason as well as the susceptibility to the actinic rays that a constant search has been made for an effective substitute. Among the plastic materials that have been suggested and on which patents have been issued are: higher organic cellulose esters, such as cellulose laurate,[5] mixed cellulose esters such as cellulose acetobutyrate,[6] cellulose ethers, such as ethyl and benzyl cellulose,[7] regenerated cellulose,[8] casein,[9] bleached crepe rubber,[10] glucose,[11] vulcanized rubber,[12] toluol sulfonamide aldehyde resin,[13] vinyl compounds such as vinyl acetate[14] and polyvinyl alcohol,[15] the glyptal resins,[16] such as the reaction product of phthalic anhydride and glycerol, and the alginates[17] derived from seaweed. Most of the above have some drawback either chemical, physical, or economic that so far has prevented their acceptance by the trade.

The greatest activity in the patent field in the last few years has been concentrated on the use of esters of acrylic and methacrylic acid polymerized singly[18] or conjointly.[19] These resins are clear, elastic, moldable, non-discolorable by actinic rays and adherent to glass. They are at present quite expensive to produce in comparison with the cellulose esters but large scale production should reduce costs.

Another promising resin is the acetal[20] from polyvinyl alcohol and an aldehyde. This condensation product is resistant to mechanical, chemical and atmospheric influences, shows remarkable strength, can be easily molded and does not discolor (*Continued on page 56*)

1. Acrobat performing on Hitest Du Plate safety glass made with vinyl plastic. 2. Fordham University pitcher testing the same material. 3. Cutting cellulose acetate sheets to pattern. 4. Sandwich assembly line in Libby-Owens-Ford Safety Glass plant. 5. Inserting safety glass sandwich into special cradle prior to lamination in the autoclave. The glass coming off the rollers, shown at the right, has just gone through the pressing machine where it is given a preliminary squeeze before going into autoclave for final hydraulic pressing



ENDORSED BY MANY PROMINENT MOLDERS...FROM COAST TO COAST

The first H-P-M Hydro-Power Plastic Extrusion Molding Press was installed several years ago in the plant of a prominent molder. This proved to be the forerunner of an unprecedented demand. For today, H-P-M Hydro-Power Plastic Extrusion Molding Presses are increasing opportunities for molders from coast to coast by broadening their markets, lending a greater degree of versatility to product design, reducing die and operating costs. Plastic molders readily endorse the H-P-M Hydro-Power Extrusion Molding Press as a practical and worthy contribution to the plastic molding industry. Write for complete information.

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PLASTIC EXTRUSION MOLDING PRESS

BACKSTAGE

New plastic exhibited at N. Y. Electrical Society

At the meeting of the New York Electrical Society held December 16, the new crystal clear plastic, Lucite (formerly called Pontalite), was discussed and exhibited. For the first time the lately discovered brilliant phosphorescent quality of this new thermoplastic resin, recently announced by the Du Pont Company, was disclosed, and its faculty for edge lighting explained.

A. E. Pitcher, general manager of the Plastics Department of E. I. du Pont de Nemours & Company, Inc., spoke on the development of plastics in general and Lucite in particular, which, he stated, are the result of the sweat and not the magic of chemistry. The magic of chemistry exists, he said, but it is produced through the coordinated efforts of technical minds and not by waving a wand. The work of a countless number of men and years goes on step by step until a synthetic product is obtained and even after such a product is achieved by the chemist, it takes patience and research on the part of men in various industries who must experiment in order to apply the synthetic product to their particular uses.

Mr. Pitcher pointed out that even with the background and foundation of organic chemistry as a starting point, it took twelve chemists and twelve laboratorians five years to produce Lucite, a material which closely approximates natural quartz crystal in optical qualities, clarity, and general appearance.

Clarity through a 9 1/2 inch thick cylinder demonstrated by A. E. Pitcher, General Manager, Plastics Department, E. I. du Pont de Nemours & Company, Inc.

ABC

Cellulose Acetate
Cresylic Acid
Sodium Acetate
Acetic Anhydride
Casein

Dibutyl Phthalate
Diethyl Phthalate
Dimethyl Phthalate
Triphenyl Phosphate
Triacetin

AMERICAN-BRITISH CHEMICAL SUPPLIES, Inc.
180 MADISON AVE., NEW YORK, N.Y.

Associated Company
CHAS. TENNANT & CO. (CANADA) LTD.
372 Bay Street, Toronto 2, Canada

BACKSTAGE

In conjunction with his talk he exhibited samples of various articles made from this new material, perhaps the most beautiful of which was a crystal ball. Made from natural quartz crystal it would cost thousands of dollars whereas in Lucite it cost only a few dollars. Another article shown was a steering gear, made by a well-known automobile manufacturer.

Edge lighting faculty of Lucite shown by twisted rods and by sheet with engraved initials, N. Y. E. S.

"Edge" lighting was shown by means of a sheet of Lucite bent at right angles, with the letters N. Y. E. S. engraved across the front. This sheet, and also twisted rods and balls on the end of rods were placed over a box with electric light bulbs. Both crystal clear and brilliant colored plastic were used. When the electricity was turned on, the light went right through the sheet and rods, coming out only at the edge and across the letters engraved on the surface. The twisted rods and the right angle of the sheet illustrated how the light is transmitted around a bend. It was pointed out that this quality of transmitting light edgewise through a sheet or around a curve—a quality also possessed by quartz crystal—will make Lucite applicable for advertising signs, for the indirect lighting of instrument panels used in automobiles, airplanes, and radios, and for other industrial usage.

Impact strength of moldings increased

Moldings with more than three times the shock resistance of standard plastic pieces are obtainable with a new material announced by General Plastics Inc. The new material is called 1547 Black and has an impact strength of 0.5 A.S.T.M. It has a weight of 22.4 grams per cu. in. and permits machining and sanding of the molding and subsequent buffing back to the normal rich luster, without exposing filler spots or impairing the normal qualities of the material. Preformed with hand equipment only. Suitable for heavy duty parts and where resistance to shock is encountered.

No Leaky Connections Here!

And the reason is that BARCO Joints are used on the steam and coolant lines. This means low maintenance cost because of continuous leakproof service.

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1813 Winnemac Avenue, Chicago, Illinois

"We have settled on the use of Barco Joints as standard equipment for our Universal Mixers, as they have given us the best of service," says Eugene Schmierer, Chief Engineer, Chem. Engineering Department, Baker Perkins, Inc., Saginaw, Mich.

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HYDRO-PNEUMATIC ACCUMULATOR: For Sale—One Watson-Stillman Accumulator, high and low pressure, complete with air compressor, air receiver, motor driven high pressure horizontal and low pressure vertical pumps; also Hydraulic Presses, 27″ x 46″ and 12″ x 12″ platens. Reply Box 134, Modern Plastics.

●

WANTED—PREFORM MACHINES: Will pay cash for idle or surplus preform Presses—also Hydraulic Presses, Pebble Mills, Mixers, Sifters, etc. Send us your list. Consolidated Products Co., Inc., 13-14 Park Row, New York City.

●

FOR SALE: Stokes Model "R" and Rotary "D" Preform Machines; Birmingham 15″ x 36″, 16″ x 42″ Rubber Mill and Calender; Werner & Pfleiderer Mixers, 9, 50, 100 gallon capacities. Stein-Brill Corporation, 183 Varick Street, New York, N. Y.

●

HARDWOOD SAWDUST: We manufacture Dustless Double screened Maple and Birch Sawdust used in the Plastic Industry, in fine, medium and coarse sizes, also softwood. Ask for free samples and prices. National Sawdust Co., Inc., 104 North 6th Street, Brooklyn, N. Y.

●

Ohio Firm has opening for a Superintendent to assume full charge of a molding shop. Must state full particulars in application. Reply Box 176, Modern Plastics.

●

First-class sales representatives required in the principal districts of U.S.A., Canada, South Africa and British India. Reply Box 177, Modern Plastics.

●

FOR SALE: Two ATTACHMENT CAP MOLDS, thirty impressions each, small round hole, large oblong hole. Practically new. Reasonable. Reply Box 178, Modern Plastics.

●

FOR SALE—MOULDING HAND PRESS—ca. 30 tons, modern German make, sacrifice $250; also some dies. Reply Box 173, Modern Plastics.

●

POSITION WANTED—MANUFACTURING EXECUTIVE—Broad general mfg. experience (Plastics, open and injection molding). Capable business expansion, conscientious hustler, wishes to change for better opportunity. Charge of dept., et. Mfg. or sales end. Reply Box 174, Modern Plastics.

●

FIRST CLASS TENITE MOULDING FOREMAN. Thorough Mechanic and experienced on extrusion moulding. Write stating age, salary expected and past experience. Location Connecticut. Reply Box 179, Modern Plastics.

●

WANTED: Thoroughly experienced man, capable of assuming full responsibility in the designing and selling of high speed hydraulic presses. Good salary. Must have successfully handled similar jobs. Reply Box 180, Modern Plastics.

BACKSTAGE

Industrial Color Service

Formation of an Industrial and Transportation Color Service has just been announced by The Sherwin-Williams Company. It is under the direction of R. H. Hookway, Sherwin-Williams colorist. This new department combines its efforts with those of the S-W Paint Engineering Service to offer designers, manufacturers and industrial consultants assistance not only in developing desired colors and combinations for "dressing up" new or old products, but also information on types of finishes and their suitability for specific application requirements. After the color scheme is worked out, panels and paint-out tests are made on the material to be finished. These tests are made to assure the desired application qualities—durability, degree of gloss and color retention.

The Sherwin-Williams Industrial and Transportation Color Service applies to all types of industry and transportation. It is a specialized color service established to aid industrial designers and designers of various industrial concerns in securing effective color treatments and suitable types of finishing materials.

Outlook for 1937

"At this time last year we stated we expected a continued improvement in business for 1936, but the outlook was not particularly good for capital goods in the public utility and transportation fields. This has been borne out," says Gerard Swope, President, General Electric Company.

"The public utilities have followed in 1936, as in previous years, the policy of giving the consumer the benefit of lower rates. As a result the use of electricity has continued to increase so that in 1936 we had the largest consumption of electric energy ever reached in this country. The people of the United States now use over four times as much electric power per capita as the rest of the world.

"For 1937 we look forward to a continuance of improvement in business. As the increased use of electric energy continues, of course there will be a decrease in the margin of surplus generating capacity, which is so essential to the rendering of good service to the public. Hence it will be necessary for the utilities to increase their plants, with a consequent expansion in orders for heavy goods, which are so much needed in our shops and general employment in capital goods industries."

New circuit breaker panelboard

A new low-cost Nofuze panelboard for general 115,-115/230 volt a-c. distribution with branch circuits ranging from 15 to 50 amperes capacity and claimed to sell for approximately two-thirds the price of previous circuit breaker type panelboards is announced by Westinghouse Electric & Manufacturing Company.

BETTER EVERY YEAR

1897 Stokes 1937

MODERN PLASTICS

Since 1897 this company has been one of the leaders in the field of hard rubber and plastics. Feeling the responsibility of leadership, we have each year bent our energies to producing MOLDED PLASTICS of ever finer quality. That we have succeeded may be judged by the widespread demand for

STOKES PLASTICS & HARD RUBBER

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Trenton, N. J.
Canadian Plant, Welland, Ontario

LOOK FOR THE MARK OF QUALITY

Reg. U. S. Pat Off.

MAKALOT
UNIFORMITY

MOLDING COMPOUND • SPECIAL MATERIALS • RESINS AND VARNISHES

"MAKALOT DID IT" a phrase fast becoming a pass word among Molders, but just as important to production men is "MAKALOT CONTINUES DOING IT": Heat after heat, drum after drum, order after order, the sterling performance which first won recognition is so uniformly maintained as to become almost prosaic.

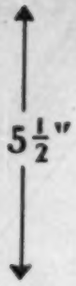
This rigidly held uniformity of MAKALOT compounds inspires the complete confidence with which our customers note upon repeat orders "SAME AS LAST."

P.S.—If you want an exceptionally free-flowing material, try our 1150 Black and 2680 Brown; quick-curing, 1022 Black and 2023 Brown will give it.

Excellent Heat Resisting and Molding qualities free from sticking or staining—75-H in Black or Brown.

MAKALOT CORPORATION
262 Washington Street, Boston, Mass.
FACTORY, Waltham, Mass.

LARGE OR SMALL *specify* WATERBURY PLASTICS



Size is no handicap here at Waterbury. The Large 16" lighting fixture bowl pictured above was molded in one of our large presses without any difficulty whatever—no special attentions or consultations were necessary. To Waterbury Plastic craftsmen it was no more different than any other big job. It was also designed by Waterbury to give maximum light without sacrificing beauty and Electrical Testing Laboratories accredited it with one of its highest rankings for light output. In contrast the little vanity case button will give some conception as to our abilities for competently handling small moldings. To get the best in plastics—don't gamble—be sure—Specify Waterbury Plastics.

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PLASTIC DIVISION
EST. 1812
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DU PONT

P.A.C. FORMALDEHYDE
U. S. P. Solution; Water White; Low in Acid; Low Metal Content

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95% Minimum Strength

HEXAMETHYLENETETRAMINE
Products of Dependable Uniformity
. . . Prompt Shipments in Modern Containers

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E. I. DU PONT DE NEMOURS & COMPANY, INC.
Wilmington, Delaware

District Sales Offices: Baltimore, Boston, Charlotte, Chicago, Cleveland, Kansas City, Newark, New York, Philadelphia, Pittsburgh, San Francisco

BACKSTAGE

The new panelboard is particularly suited for application in industrial plants, buildings, schools, hotels and all types of commercial structures, yet because it uses the multi-breaker units recently developed for load centers the cost is only slightly higher than for conventional switch and fuse type panelboards and offers all the advantages of circuit breaker protection.

Errata

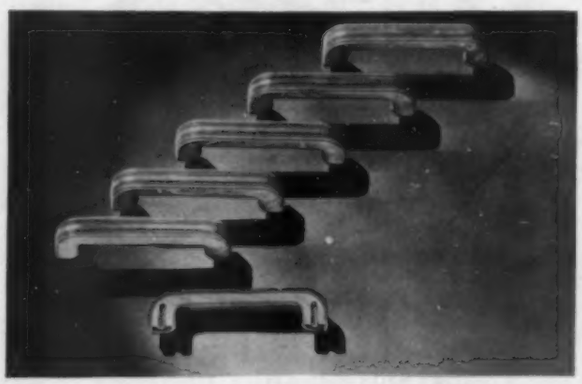
The Voges Manufacturing Company, listed in our October Directory as cast resin fabricators, are also molders of phenolic and urea materials.

Properties chart of all plastics

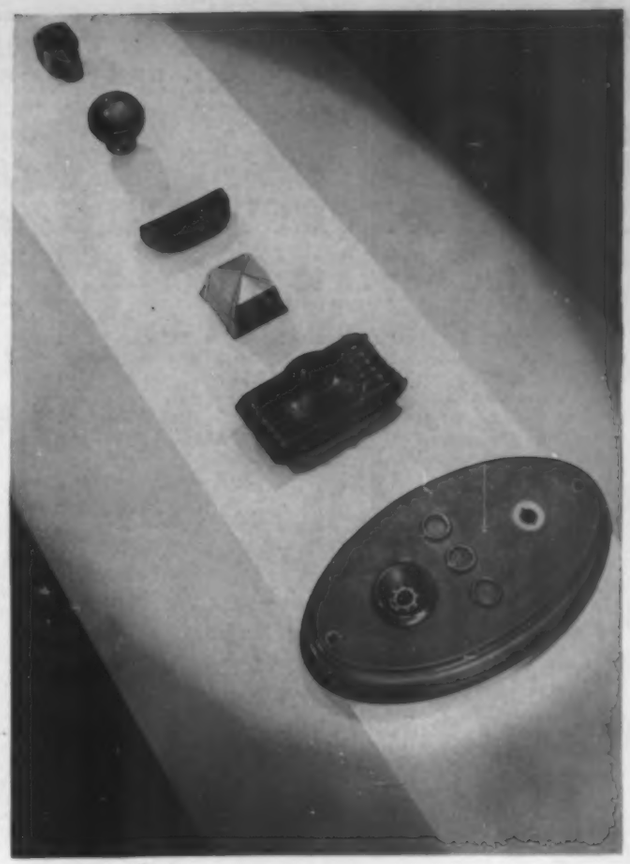
The chart showing comparative physical properties of all plastic materials which appeared in the October issue of MODERN PLASTICS has been reprinted on thin map papers for framing or filing for permanent reference. It is the first time these properties have been assembled for easy comparison and makes the choice of materials for special applications comparatively simple. 50 cents for each chart postpaid.

Handles of Tenite

Outstanding beauty and unusual rigidness are combined in this plastic refrigerator door handle, injection molded of Tenite by the plastics division of the Erie Resistor Corporation, for the Stewart Warner Corporation. An unusual feature in this article is that it consists of a plastic shell approximately 1/8 in. in thickness



molded around a zinc core measuring 1/4 in. in thickness and 4 in. in length. As far as it is known, this is the first time a metal core of this size has been successfully coated with a plastic covering in America on a production basis. The zinc castings are used just as they come from their die, no finishing is required and any variations in their surfaces are compensated for in the molding operation. The only finishing operation necessary on the molded product is the removal of one gate.



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Sixty years of Plastic Molding Experience—places Auburn Button Works definitely to the front as pioneer plastic molders. In this time Auburn has accumulated a vast fund of experience that saves you in numberless ways but costs you not one penny. Years of turning blue prints into entirely new products and at the closest of tolerances is an aid to your design problem that must be used to be fully appreciated—On your next molded plastic problem—Specify Auburn.

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The most modern molding press will be inefficient

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machine backs it up!

Colton Preforming Machines are the accepted standard in the plastics industry not only because they speed up the molding cycle but because their unvaring accuracy of performance is a guarantee of better molding at the press. When Colton preform-pellets are used material waste is eliminated, flash is held to the ideal minimum, material handling problems are simplified and costs d
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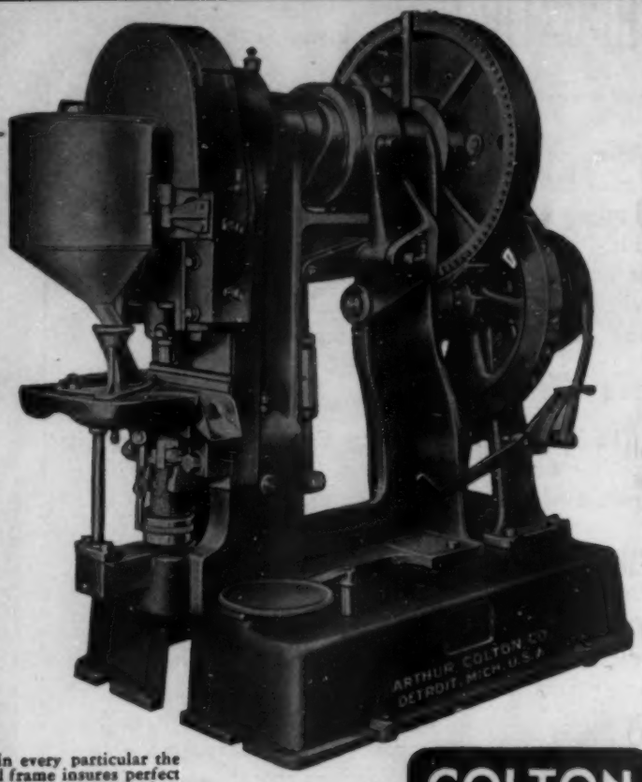

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COLTON DETROIT

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We would appreciate having an opportunity to discuss new developments with you.

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ORTHODICHLORBENZENE
AMYL, BUTYL and ETHYL ACETATE
DIACETONE ALCOHOL
MERSOL (Solvent Alcohol)

CHEMICALS OF QUALITY
Monsanto
ST. LOUIS, U.S.A.

BOOKS OF THE MONTH

Booklets reviewed in these columns will be sent without charge to executives who write for them on their company letterheads. Other books will be sent postpaid at the publishers' advertised prices.

Plexiglas properties and uses

A booklet recently issued by Röhm & Haas sets forth the optical, physical, electrical and chemical properties of Plexiglas. It gives directions for working the material and suggests new uses as well as lists available cast forms. Plexiglas, it states, is a polymerized derivative of acrylic acid recently developed as a member of this interesting class of synthetic materials. It is a colorless, transparent, thermoplastic solid, which shows no discoloration nor change of properties upon aging.

"Plexiglas is distinguished from other organic thermoplastics in that it looks very much like ordinary silicate glass, while it retains the properties of an organic resin. As Plexiglas may be bent or formed into various shapes without developing any strains or blemishes and also is practically non-breakable when used in thickness of one-fourth inch, it has many uses for which silicate glass would not be practical.

"As an organic resin, Plexiglas exhibits great stability to weathering, is quite hard, elastic, and chemically stable. Its toughness, perfectly colorless transparency, and the ease with which it may be worked add to its possible uses as a thermoplastic material," says the introduction to the booklet.

Catalog and directory number

The 332-page October issue of MODERN PLASTICS which includes a complete résumé of materials, methods and equipment together with directory, bibliography and nomenclature of the plastics industry bound in hard covers is available to readers at $2.00 per copy postpaid while the supply lasts.

Insurok handbook

A twenty-page booklet has just been issued by the Richardson Company on their phenolic laminated material Insurok. The preface defines the ideals of the company and then the different grades of the material are described as well as the technique of fabricating. Complete specifications and some of the applications of Insurok are listed.

Pontalite (now called Lucite) booklet

Technical information on Pontalite, the new organic plastic announced at the Pittsburgh meeting of the American Chemical Society, has been made available for engineers and designers, for fabricators of plastics and molders who are equipped with injection presses.

In a booklet just issued by the Plastics Department of E. I. du Pont de Nemours & Company, it is explained

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RESIN COLORS
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UNIFORM
A COMPLETE LINE OF COLORS SPECIALLY MANUFACTURED FOR BOTH MOULDED AND CAST PLASTIC COMPOUNDS
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INJECTION MOLDING

We solicit inquiries from firms desiring molded plastic parts for all types of industrial products. Our long experience in meeting the needs of many manufacturers along these lines qualifies us to aid you. Our completely automatic, modern machinery insures minimum costs and highest quality.

Place your problems before us. We assure you full cooperation.

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OUR NAME TAKES ON NEW MEANING WHEN IT COMES TO A JOB LIKE THIS

"Accurate" is more to us than the first word on our letterhead. As proved by this difficult hollow-shape assembly, we carry the name right into the plant . . . with molding methods that insure perfect assembly of molded parts even when selected at random. We're accurate about costs, too . . . and doubly accurate about delivery dates.

If you seek a custom molder for that difficult job . . . and at the right costs . . . direct your inquiry to—

ACCURATE MOLDING CORPORATION
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BOOKS OF THE MONTH

that Pontalite is a polymerized derivative of methacrylic acid, and may be obtained as a cast resin in the form of sheets, rods and tubes, and as a thermoplastic molding powder. In both forms it will be available in March 1937 as a crystal clear product and in a wide variety of brilliant transparent, translucent and opaque colors.

This booklet describes the physical and chemical properties that apply in general to the cast product and the molding powder, which have not been plasticized. It is stated that Pontalite molding powder will be offered with various percentages of plasticizer, which, in effect will somewhat alter the mechanical and thermal properties to the extent of reducing hardness and increasing thermoplasticity.

The subjects discussed in the booklet include this plastic's physical, thermal, optical, electrical, chemical and working properties. There also are sections on compression molding and injection molding.

Induction motor bulletins

A series of new bulletins has just been released by The General Electric Co. They describe general purpose squirrel cage induction motors, splashproof motors, totally enclosed fan-cooled induction motors, explosion proof totally enclosed motors. And there are two one-page sheets describing hoist motors and other induction motors manufactured by this company. All the bulletins are illustrated.

Hydraulic press equipment

R. D. Wood Company has prepared some interesting literature and reference sheets of standard valves used in connection with hydraulic press equipment for the plastics industry.

Precision lathe catalog

The South Bend Lathe Works have published a 24-page catalog announcing their new 1937 9-inch workshop precision lathe. Over 150 illustrations show the many new styles, features and applications of the new back-geared, screw-cutting lathe.

Johns-Manville Industrial Products

The 1936 edition of the Johns-Manville Industrial Products Catalog is now available. This 60-page book contains a wealth of information and recommendations on high and low temperature insulations for every industrial need, specifications on bonded asbestos built-up roofs, and insulated roofs; detailed information on corrugated transite for roofings and sidings: on industrial friction materials; on transite conduit, asbestos ebony and other electrical materials; on transite pressure pipe for water lines; and on packings.

A Revolutionary NEW DELTA
6" UNIVERSAL SURFACER

Built like a machine tool, the new Delta No. 1400 Belt Surfacer offers maximum value at minimum expense. For removing burrs, polishing small parts, trimming and finning die castings, squaring ends of bars and tubes, finishing miter and other angular cuts on metal mouldings, satin-finishing plated parts, removing flash on Bakelite and other plastic parts and for dozens of other uses around the shop this machine will save time and money. Investigate its possibilities today. Write for full information.

Welded steel stand available to make machine completely self-contained and portable. Belt guard available to complete guarding of machine.

Machine completely equipped with New Departure double-seal ball bearings, lubricated at the factory for the life of the bearing. Machine completely enclosed and guarded to comply with safety requirements. Portion of belt being used is the only moving part exposed.

Exceptionally heavy main drive shaft, carrying 5½" diameter drum. No rubber covering required on drums, eliminating replacement expense. Large driving pulley for V-belt drive. Adjustable deflector on drum hood, and complete enclosure of machine enables from 85% to 90% of sanding dust to be collected by exhaust system—impossible with open-belt machines.

Machine operates vertically or horizontally. Back stop for polishing short pieces, fence for polishing and finishing long pieces and tilting table for use in shaping and burring work available if desired. Tilting table has groove for miter gage.

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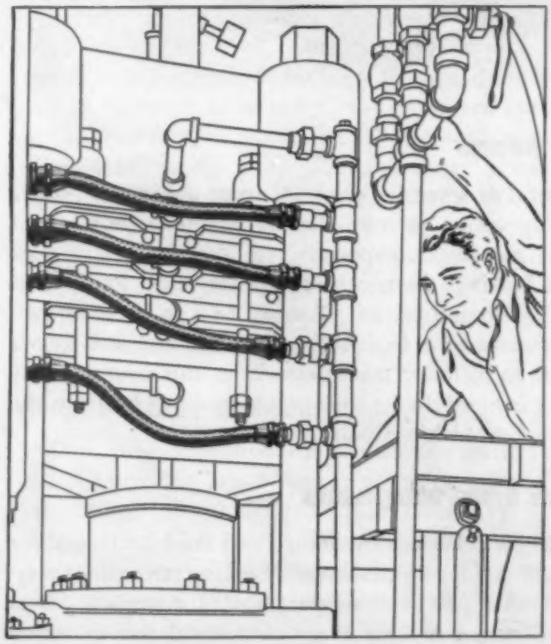

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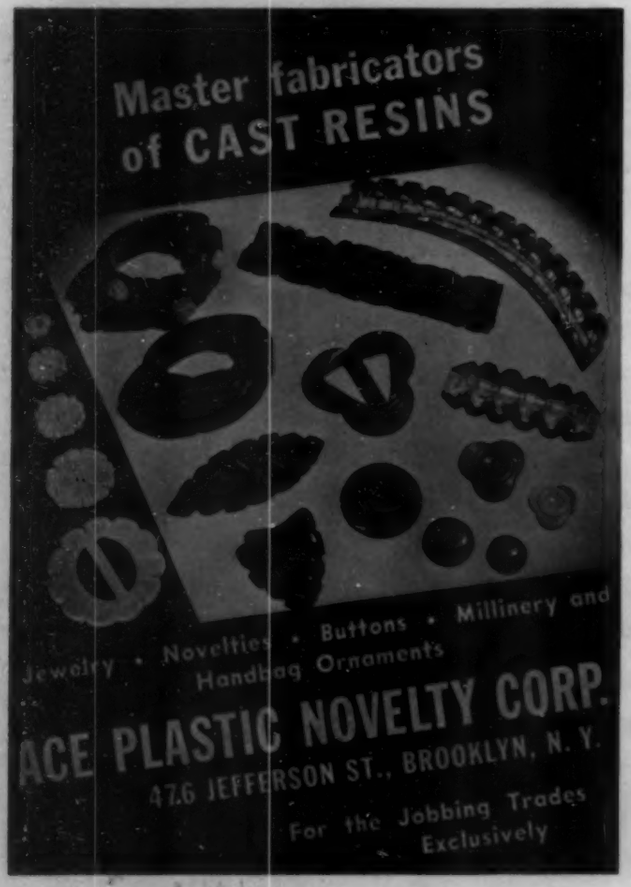
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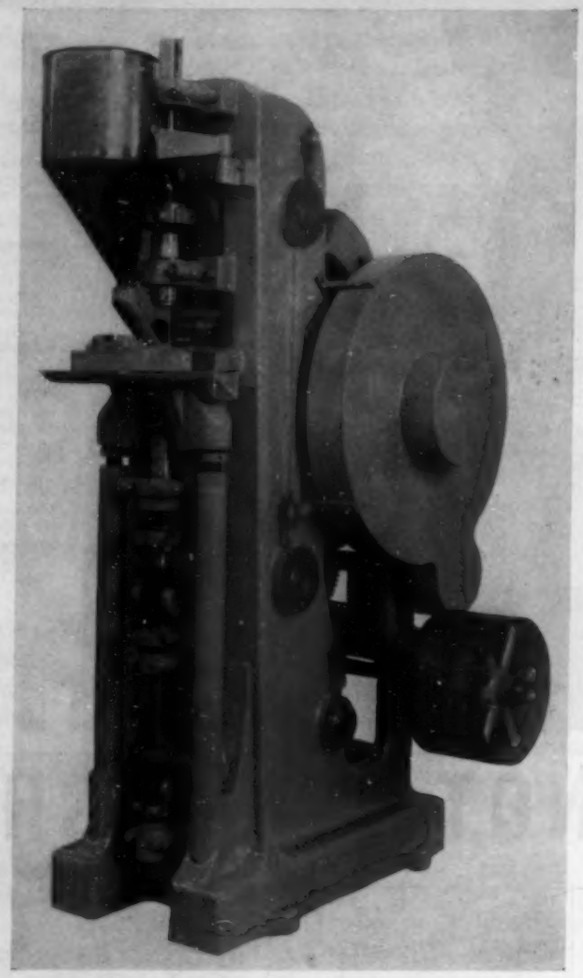
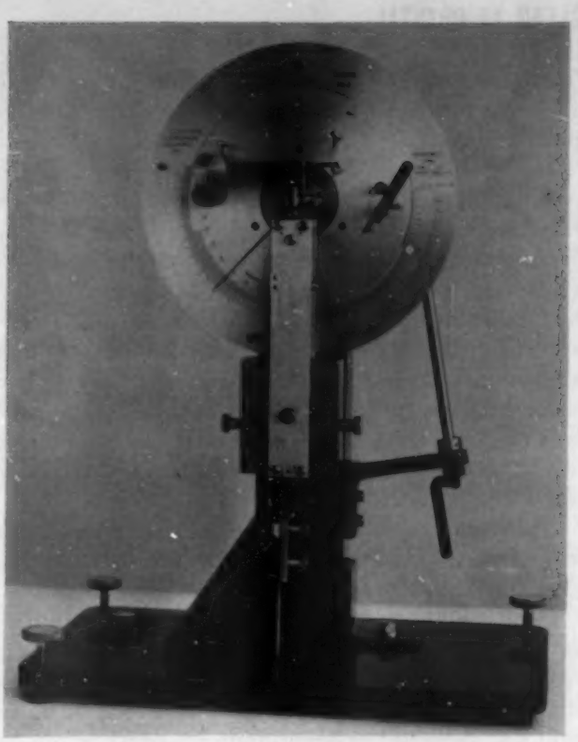


Stokes preformer

Typical of several special "S" type automatic presses applying up to 30 tons pressure in the preforming of plastic molding compounds, in the manufacture of oilless bearings from copper powder, etc. Production 20 to 25 per minute on pieces up to 4 in. in diameter. Such presses have been shipped to England and Russia as well as to many manufacturers in this country. Its weight is more than 5 tons. Designed and built by the F. J. Stokes Machine Company.

Schopper Dynstat testing machine

The new Schopper Dynstat testing machine is used for determining dynamic and static bending strength of plastics, hard rubber and similar molded materials. It is said to permit making every mechanical test to which makers and users of insulators and other molded materials attach special preparation, but can be made from the finished articles. For determining impact bending strength, the tester is equipped with two hammers which



permit making tests of 0 to 10 cm/kg. and 10 to 20 cm/-kg., working capacity from a drop angle of 60 or 90 degrees. For statical bending strength tests the ranges are 0 to 5, 0 to 9.8 and 0 to 40 cm/kg.

For determining impact bending strength the specimen is placed on an anvil of special design, and the pendulum is allowed to fall free from a pawl. An idle pointer on the left then indicates the rise of the pendulum on the corresponding scale after the impact and provides a reading of energy absorbed. For a statical bending test the specimen is clamped on the rotating axis of the machine and is subjected to bending by turning the center part of the scale dial, to which it is also secured by means of a crank and worm gear. This causes the pendulum to move to the right, and the value of the bending moment is measured by the right-hand idle pointer. Impact bending strength is made in the Izod system, and the clamps for the statical bending test are of the Naumann-Schopper design. This new testing machine is distributed in this country by Testing Machines Inc.

Marquette profiling attachment

This three dimensional automatic universal profiling milling machine attachment is specially designed to be attached to any milling machine for heavy work on drop-forging dies, blanking, forming and other kinds of press dies, etc. The copying mechanism works in a ratio of 1–1 and by means of the tracer and its mechanism it is possible to use patterns or models of soft material, such as plaster or wood. Tracer and cutter-head are mounted in a rigid housing, to facilitate accurate work at high production rates. Specifications are available from the Marquette Mechanical Engineering Company.

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●

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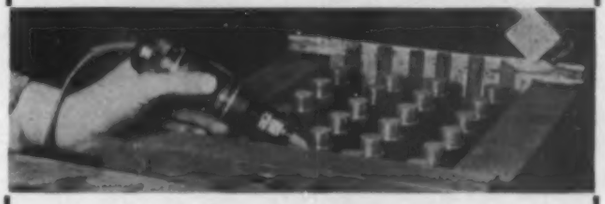

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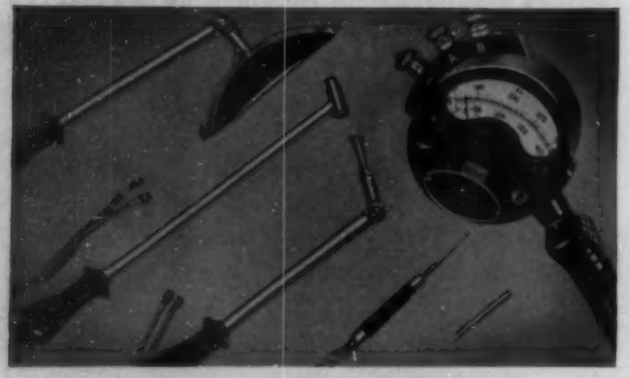

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CLEAR AS CRYSTAL

(*Continued from page 27*) and solid blocks, these available shapes may be combined with molded forms to complete designs.

The greatest opportunity for transparent resins lies, perhaps, in the decorative possibilities of their clear transparency but this will in no sense limit their application because they may be obtained also in delicate transparent shades of color as well as opaque. Models may be turned out easily and machined on quite simple shop equipment and we shall gladly cooperate with designers and manufacturers who are interested to experiment with them. Samples may be obtained for such experimental work and a booklet has been prepared which sets forth their physical properties, both free for the asking on business stationery.

The violin and flute shown here point to the opportunities afforded by transparent resins which do not change their appearance in service and many ideas will naturally present themselves to those who are thinking in terms of plastics production. The packaging and decorating fields, for instance, will welcome these materials and designers with a pioneering spirit and creative ability will find them full of opportunity for new contacts and departures from traditional uses of plastic materials.

CREATING DESK SETS THAT SELL

(*Continued from page 32*) phenolic resin, was chosen for the base, first because it could be obtained in attractive colors, second, its wearing qualities are excellent. It is not easily broken or marred by stains of any sort. The material used is cut from rod stock and is hand buffed even to the edges which gives it a highly polished, smooth surface. However, it was found that these bases were not heavy enough when plastics were used alone—they moved easily at a slight touch—so he added another base under the original one which he now called the top base. In some sets these under-bases were made of metal (brass, nickel, chromium or gold plate) and in others, he used cast resin in colors to harmonize with the top base. Then, just for variety, some of the sets were made with ball feet instead of the under-base. Only the rim of the under-base is visible and it not only gives weight to the set but lends itself to the design which is further carried out by a small, matching disc in the center of the top base. This disc is two-fold in purpose since it covers any roughness which occurs in drilling the small holes necessary to attach the pen socket, and carries out the design harmoniously. Both the under-base and the plastic disc are attached to the top base by screws through holes which are drilled and screw-threaded.

The pen socket is made of a plastic compound exclusive with the Sheaffer Pen Co., and is particularly well adapted for this application because it insures the socket from shrivelling or becoming soft in use. The socket is connected to the disc by a screwed-in swivel. Even the swivel is planned for convenient use. Unlike others, it

can be easily swung and adjusted to any angle desired by the user of the pen and the position is maintained until readjusted and it won't change with the removal or replacement of the pen. When the set is boxed the swivel can be made to lie flat which makes the packaging of these sets a simple task.

To complete this line of gift sets, there are double pen stands and a number of designs which include desk lamps where metal is combined with plastics in a delightful way. A chromium trimmed lamp for example has an enameled finish shade to match the cast resin base.

"Cast resinoid," says Mr. Tibbs, "is much more easily workable than glass where holes are essential to assembly and design. I believe there is ample opportunity for the use of all plastics in untried ways but it is difficult to win over some manufacturers to this belief since they too often rely upon material alone without enhancing it by any particular adaptation of modern design. Unfortunate design is a real handicap in the popular sale of any item because, in the final analysis, a prospective buyer is initially attracted by size, shape and color rather than by material. Material becomes a matter of interest or even conjecture usually after form and color have made impress. This is particularly true today when people are more conscious than ever of the fact that even common objects of utility can be as decorative as they are useful and govern their purchases accordingly."

The illustrations shown indicate how attractive these sets really can be and one can readily imagine that they are colorful enough to meet almost any scheme of decoration or interior design. That practical advantages and useful intelligent adaptation, without loss on the side of attraction, can be obtained by the use of plastics is also obvious.

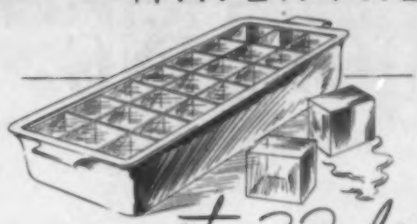
THREE-IN-ONE

(*continued from page 21*) with the Tenite grilles lock these two grilles in place and are screwed to the main body of the piece from underneath. Another important consideration was the allowance of enough tension between the various pieces when assembled to prevent the cabinet from chattering upon the full turning on of the speaker volume. Here, the slight natural warpage of the grilles was used to advantage to obtain this desired tension.

Plastic pieces of different materials and colors do not shrink evenly upon being cured, and thus wherever the pieces are joined together, a step should be incorporated in the design as we have done in ours over the top, to take up whatever discrepancies might occur. If a flush joint were used in such a case, a difference in size due to unequal shrinkage would be immediately apparent.

Plastic molding lends itself to a particular type of design characteristic of itself and foreign to other materials. It is the staunch adherence to this theory in design that brings out the intrinsic beauty and fundamental rightness of the plastic piece. Corners should be rounded, not sharp, not so much because it is contemporary to have them round or "streamlined," but because it is

YOU KNOW WATER FREEZES



at 32 degrees

And you know it boils at 212°. But what about other temperatures? Without a suitable instrument for temperature checking, you don't know whether a mold is right for curing. The Cambridge Mold Pyrometer offers an easy, accurate and quick means of checking temperatures. No more "off-colors" from overheating. No more soft centers from under-curing.

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logical and satisfying to the intelligence; a square corner in a large plastic piece would be unpleasantly sharp, flow marks would show, and in handling it would be more likely to get broken. Curves and radii cause highlights on the piece, which emphasize the superiority of luster and depth that plastics have over other materials. For these reasons all the corners of the design were rounded, with the exception of the bottom, where, of course, the mold was parted.

The cabinet has a simplicity which harmonized with all types of interiors and is available in various color combinations, from delicate orchid and ivory for milady's boudoir, to potent reds and blacks which add a dramatic note to the modern metropolitan apartment, with intermediate quiet browns and greens which blend unobtrusively with the average type of furnishings.

The compactness of this set in spite of its six tubes, gave the designers license to use colors of greater brilliancy, with the thought that the radio analogous to the brilliant vase or other art object would furnish the key of contrasting color in a room. Plastic radio cabinets in the past have usually been in drab and obviously imitative walnuts and mahoganies, the imitation of any other material such as wood or marble rather than using the depth, brilliance and translucency that plastics afford is an anathema to all designers. The variegated, transparent and metallic effects of cellulose acetate, the pure colors of ureas, and the depth and sheen of phenolics make this idea possible, and these materials are certainly at their best expression when they obtain effects unique to themselves and possible with no other material. Certain colors and variegations we associate with cheaper preceding materials and the repetition of these effects should be avoided as a public prejudice against a color or material takes a long time to overcome. The secret of color success lies in getting pleasing and unusual colors such as are not met in every day experience and are refreshing and novel to the eye. Chicago Molded Products Corp. molded both housings and grilles.

LAMINATED SAFETY GLASS

(*Continued from page 40*) in use. Both the acetal and the acrylic acid esters hold great promise for the future of laminated glass. Since their strength and adherence to glass eliminate the necessity of separate layers of adhesive and reenforcing material and since their resistance to moisture obviates the edge sealing required by the cellulose plastics, the manufacture of the laminated glass is greatly simplified.

The plasticizers

Two of the most common defects in laminated glass until the beginning of this decade were the formation of bubbles in the plastic and separations of the plastic from the glass. It was definitely determined by research that these faults were the result of the volatilization of residual low boiling point solvents such as the acetone and acetone-alcohol solutions used in the cellulosic plastic. The substitution of high boiling point plasticizers for

the low boiling point solvents was a great step forward in remedying these difficulties in quantity production.

The plasticizers employed in this art must have certain basic properties: a high boiling point and a low vapor pressure so that they will neither volatilize during the hot pressing of the assembly nor form bubbles in the finished product; colorless so that the transparency of the laminated glass plate will not be impaired; inert to chemical change under the conditions of light and temperature to which they are subjected in the finished product; a permanent softening and plasticizing action on the plastic material of the interlayer. Dibutyl phthalate,[21] diethyl phthalate,[22] triacetin,[23] diethyl tartrate,[24] dibutyl tartrate,[25] tricresyl phosphate,[26] benzyl acetate,[27] triphenyl phosphate,[28] glycols,[29] higher alcohols,[30] halowax oil,[31] butyl carbitol, butyl stearate, diethyl malonate, diethyl succinate, methylhexylcarbinol, benzoyl benzoate and the glycol dihexoates[32] have been claimed to meet these requirements and some of these have been extensively used as plasticizers.

The use of large proportions of these plasticizers keeps the cellulosic material permanently plastic and practically eliminates separations. These plasticizers play an equally prominent part in conjunction with the use of resins in laminated glass. As with the cellulose esters, the properties of the resins with respect to plasticity, strength and adherence are greatly dependent upon the selection of a proper plasticizer.

The adhesives

If the plastic interlayer has not in itself the property of adherence to glass, a very thin layer of an adhesive must be used. Because of the extreme thinness of this layer, almost any adhesive material has sufficient transparency. The following have been used and suggested for use: gelatine,[33] Canada balsam,[34] casein,[35] polymerized esters of itaconic acid,[36] vinyl compounds,[37] chlorinated diphenyl,[38] urea-formaldehyde condensation product,[39] glyptal resin,[40] vegetable proteins,[41] such as gliadin, zein and hordin, acid or alkali treated cellulose esters,[42] polymerized acrylic[43] and methacrylic[44] acid esters and polyvinyl acetal[45] resins. Certain boron compounds[46] have been found to increase the adhesiveness of alkaline metal salts such as sodium stannate and sodium silicate. Certain weak acids[47] such as silicic acid, stannic acid and arsenic acid, have of themselves no noticeable adhesive properties but when used between glass and cellulose ester plastic at a temperature of 200° F. and up they become powerful cements.

The future of safety glass

The industry is still searching for the ideal plastic for use as the interlayer. It must be transparent, adhesive to glass, permanently plastic at all temperature ranges of use and impervious to deteriorating atmospheric influences of moisture, heat and light. Such properties are claimed for some of the resins previously referred to but so far lack of production facilities or uniform results from the methods employed as well as high cost have retarded their large scale adoption by the industry.

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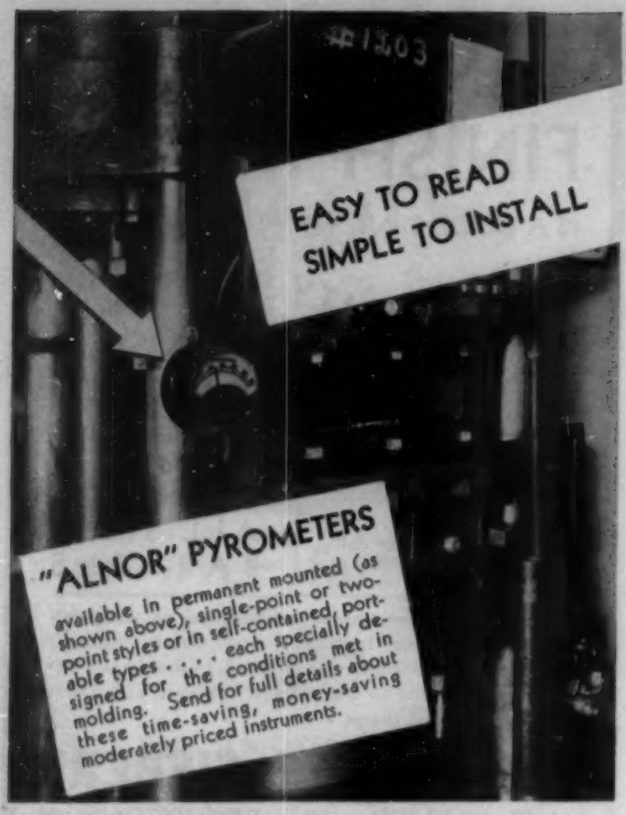
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The final step in the cycle of the development of safety glass will come when the glass itself is eliminated. Glass is dangerous not only because of the splinters that can separate from the glass itself but also because it presents in the laminated form a hard surface that can crack a skull on forceful contact in an accident. The travelling world awaits the discovery of a material that can be molded to any desired shape, that can be given a surface sufficiently hard to resist abrasion under ordinary conditions of use, that will resist the deteriorating effects of light, moisture and heat, but which will not be hard enough to cut the flesh or break the bones of a human being on violent contact. These specifications are difficult, yet not impossible. If the present progress in the development of new plastics generally and synthetic resins in particular is continued, the day is not far off when the ideally safe plastic windshield will remove one of the great hazards of the automobile.

1—Wood, 830,398.
2—Benedictus, 1,182,739.
3—Sherts et al., 1,781,084.
4—Geistharp, 1,936,231.
5—Hagedorn, 1,861,915.
6—Hagedorn, 1,861,915.
7—Walsh, 1,936,044.
8—Benedictus, 1,098,342.
9—Benedictus, 1,098,342.
10—Randall, 1,693,729.
11—Goetzke, 1,224,530.
12—Randall, 1,748,079.
13—Gardner, 1,762,513.
14—Walsh, 1,835,619.
15—Davidson, 1,929,352
16—Rohlfs, 1,899,588.
17—Walsh, 1,923,248.
18—Geisel, 2,007,645.
19—Neher, 1,937,323.
20—Fix, 2,045,130.
21—Walsh, 1,936,044.
22—Walsh, 1,936,044.
23—Walsh, 1,936,044.
24—Dreyfus, 1,924,398.
25—Moss, 1,849,504.
26—Walsh, 1,936,044.
27—McNally, 2,026,987.
28—Walsh, 1,936,044.
29—Sherts, 1,781,084.
30—Cottet, 2,041,528.
31—Neher, 2,032,663.
32—Fix, 2,045,130.
33—Watkins, 1,963,601.
34—Brown, 1,656,691.
35—Wampler, 1,963,569.
36—Hope, 1,644,131.
37—Moss, 1,831,462.
38—Gardner, 1,836,914.
39—Moss et al., 1,870,018.
40—Rohlfs, 1,899,588.
41—Clewell, 1,915,048.
42—Ryan, 1,976,749.
43—Renfrew, 2,024,389.
44—Renfrew, 2,024,389.
45—Fix, 2,045,130.
46—Fix, 2,003,288.
47—Fix, 2,009,441.

THE OAKLAND–SAN FRANCISCO BAY BRIDGE

(*Continued from page 19*) will be self-evident to resident pilot and stranger alike. Six rotating beacons are equipped with 24-inch parabolic silvered glass reflectors and lamps which produce, in each beacon, an 8,000,000 candle power beam.

The operating condition of these beacons is continuously and automatically portrayed upon the plastics control panel. In the event that there is any interference with, or failure of, any of the lights in the complicated bridge system the corresponding indicator lamp on the control panel automatically brings this information immediately to the attention of the control sergeant. As he sits at his desk facing this miniature replica of the bridge, set in the wall in front of him, he is kept in constant touch with the condition of myriad lights and complicated safety systems essential to the operation of this greatest of all bridges. In case of a current failure at any point the throwing of a single switch at the control panel restores service. Where 15 minutes to 1 hour would be necessary to restore service with manual control, this work is performed by the control board in 15 seconds. This adaptation of plastics to the walls and control board of the Oakland–San Francisco Bay Bridge Administration Building should prove instructive and suggestive to those in the construction business and to the laminated plastics industry.

MOLDED ACCURACY

(*Continued from page 20*) black phenolic case is furnished for carrying it outside the laboratory. The balance weighs only 14 ounces and the case 11 ounces and can be carried under the arm or in an overcoat pocket. It is a boon for field workers and demonstrators who have need for weighing accurately at a distance from the office or factory. For protecting the balance from dust in the laboratory, a dustproof cover, made from cellulose acetate is now available.

From a molding standpoint, mention should be made here of the perplexing problems confronting the diemakers and molders[1] who were compelled to work within very strict specifications and tolerances as the slightest variation would be sufficient cause for rejection. Of the three molded parts, namely, the weighing cup, upright and base, each had its peculiar and distinct difficulties.

The base, which is 3/8-in. thick was relatively simple. Initial difficulty in molding was experienced by blistering and even rupturing at the surfaces because of entrapped gas. A hard flow material helped somewhat. After much trial and tribulation it was found that a soft flow material, in conjunction with a slow closing of the press and lower steam pressure with a longer cure finally eliminated all difficulties. The cup, which has a 1/8-in. wall, with a 1/4 in. thick base, was a mean problem. To arrive at a happy medium in curing both the side wall and base, the cycle was shortened by preheating the molding powder before use.

The upright presented a problem both in the construction of the mold and then arriving at the best way of using it. This piece is 3/8-in. thick and has holes and slots in all six sides. The mold itself was made up of four pieces which lock together to form four sides. These fit perfectly into a square hole in a solid block of steel, the bottom of which forms the fifth side. The sixth side is fitted into a square cavity to make a positive mold. The chief trouble encountered with this mold, when in use, was fitting the four side pieces together into the square opening. After weeks of disheartening labor, a special jig was devised, which held the pieces together and yet allowed them to be forced into its place. Because of the small tolerances allowed in the weight of the cup, the molding powder had to be weighed carefully to 1/10th of a gram to ensure the proper degree of accuracy in the finished balance.

Auxiliary storage kit

Another development which serves as an auxiliary to the Bennett Balance is a sample storage set designed especially for convenience and portability. The case is made of black phenolic and the vials are of transparent pyroxylin. The caps are of satin finish aluminum. Labels are unnecessary as the aluminum cap can be marked with pen, crayon or pencil. The case and vials are waterproof, greaseproof and soilproof. The vials are unbreakable and much lighter than glass. The complete set only weighs 18 ounces including box and bottles.

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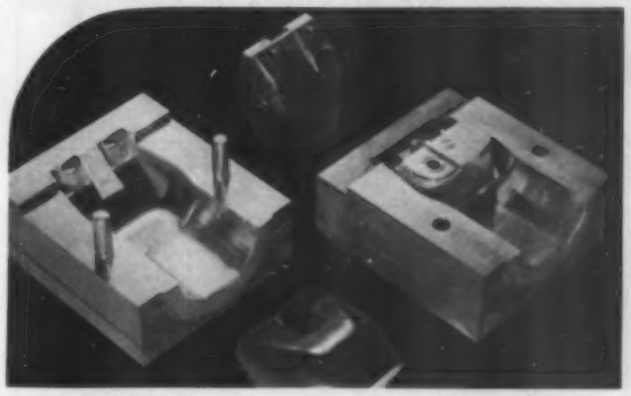

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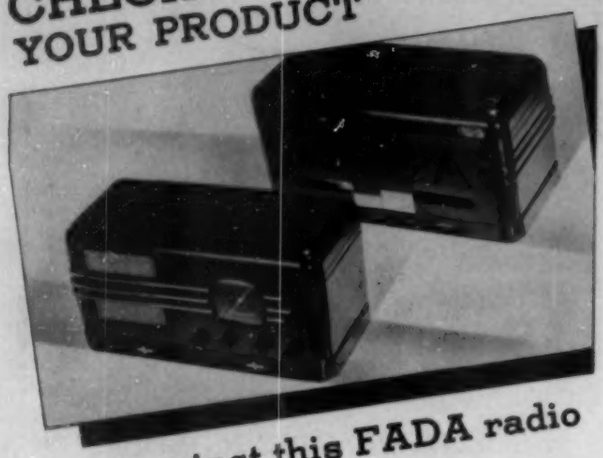

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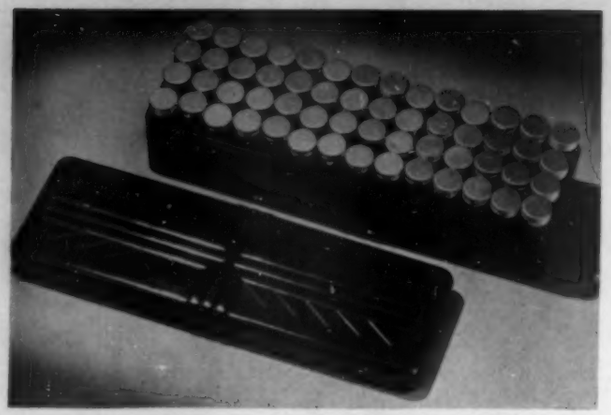

This sample storage set consists of a molded phenolic stock box and cover with vials of transparent pyroxylin

This set consists of 56 vials ($2\frac{1}{2}$ in. by $\frac{3}{4}$ in. each). It makes it possible to keep samples of chemicals, colors, powders, screws, etc., in an orderly way, in a small space and readily accessible. It can be carried by salesmen, demonstrators and technicians who travel about. Quantity production permits its sale at a price no higher than old fashioned, heavy, destructible sets.

[1] H. Jamison made the dies and molded the Bennett Balance.

MOLDING AN IMPOSSIBLE SHAPE

(*Continued from page 17*) available in the vicinity of the press and carefully lifted one end until the press was tilted at the correct angle to allow the cavities in the mold to lay flat. The press had to be securely fastened at top and bottom to maintain its position against the shock of 400,000 lbs. pressure going up and down every $2\frac{1}{2}$ minutes, twenty-four hours a day, six days a week.

In the new mold, all twelve cavities were faced the same way and the plungers were relieved to make a flash mold. The press is loaded with loose powder because it was found that preforms would break or bounce out when the press closed. The powder penetrates the cavities as it should and flows completely without trouble. The pieces roll out at the rate of about 5000 a day, have very little flash which is easily broken off, and with a minimum of finishing, the pieces are complete and ready for assembling.

The two parts of the housing are placed on either side of the metal parts of the head and held in place by two metal bands, one screwing over the molded threads at the bottom; the other screwing into the metal head, has a flange which securely grips the tops of the two molded halves. The pieces fit perfectly together without overlapping or distortion. A beaded metal chain attached to the metal top through a small hole in the plastic material of the cartridge half, is used to anchor the plastic cap which fits over the metal tube extending from the cartridge side where the bottle is charged.

The complete assembly represents an intelligent combination of plastics with metal and is an outstanding example of modern industrial design. Incidentally, the

new bottle is made entirely in America. While the old one was assembled here, the glass was imported from Czechoslovakia, the wire mesh from England. A comparison of the old syphon with the new leads one to wonder why it wasn't changed long ago!

The use of plastics permits many combinations of color without increased cost of manufacture or assembly. The first new Sparklets to reach the market are chrome with black or red trim, copper with red trim, enamel finished in blue with white trim, black with red trim and ivory with black. New combinations of color can be introduced at any time without changing dies or designs. About a quarter of a million of the old style Sparklets were sold last year. With the new design it is expected that the new Streamline Sparklet sales this year will far exceed that number.

METHODS OF TESTING PLASTICS

(*Continued from page 37*) The cutting diamond is in the form of a corner of a cube, mounted so that the diagonal of the cube is normal to the test surface and one edge is in line with the direction of the scratch. The diamond is suspended from a balanced arm pivoted on sapphire bearings. One end of the arm is provided with a spirit level and the other with a 3-gram weight which constitutes the standard load for the diamond point. The diamond is mounted at the small end of a tapered steel spring, the other end of which is fastened to the lower side of the suspension area. A vertical rack is provided for raising and lowering the bracket that carries the cutting tool. This bracket is attached to a microscope mechanical stage which is provided with suitable clamps and screw mechanism to permit the specimen to be moved slowly under the diamond point. The width of the scratch (Figure 4) is measured with a microscope having a calibrated filar micrometer eyepiece. The plastics were conditioned at 21 deg. C and 65 per cent relative humidity for at least 24 hours and the test was conducted under these same conditions. The scratch resistance is reported numerically as the quotient of the load in kilograms divided by the square of the scratch width in millimeters.

Results

The data obtained with the Bierbaum Microcharacter instrument on samples of plastics furnished by various manufacturers are shown in Table II. Each value represents the averaged result of the measurement of the widths of 10 scratches at 3 locations on each scratch.

Comparison of one value, indicated in Table II as measured with a 6-gram load, with the one above it, obtained with a 3-gram load, shows that the calculated scratch resistance value is substantially independent of the load used. This would be expected to be true, since the diamond tool is of such shape that the scratches made with different loads are geometrically similar. The width of the microcuts obtained with the 3- and 6-gram loads for this acrylate resin were, respectively, 14.16 and 20.25 microns. It will be noted that the four

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different brands of cellulose acetate, indicated by the numerals 1 to 4, vary considerably in resistance to scratching, although measurements made on sheets of different thickness from a given manufacturer show very little variation. The acrylate resins were found to be the most resistant to scratching of the materials studied.

Indentation hardness

A number of indentation tests previously developed for use with metals have been applied to the determination of the so-called hardness of plastics, including the Brinell, Martens, Rockwell and Vickers machines. Examination of data recently submitted by 7 manufacturers for the properties of various plastic products showed that 4 different sizes of balls and 4 different loads had been used in making Brinell tests on these materials. Since it is known[7,8] that the Brinell number varies somewhat with both the load and the diameter of the ball, it is desirable either to standardize upon a particular size of ball and load or to use an indenting tool which is substantially independent of the testing load, such as one of conical or pyramidal shape.

Description of indentation hardness apparatus

A Vickers Hardness Testing machine (Figure 5) was used for our measurements of indentation hardness. The tool in this instrument is a square pyramid, having an angle between opposite faces of 136 deg. A load of 5 kilograms was used. The machine is constructed so that the load is applied slowly and progressively to the test specimen, remains applied for a predetermined time, and is then automatically removed. In our measurements the load was applied for 10 seconds. A special measuring microscope is then swung into position, locating itself exactly over the impression. The lengths of the diagonals of the indentation (Figure 6) are measured by means of a micrometer ocular in the microscope. The Vickers Hardness Number is the quotient of the applied load in kilograms divided by the pyramidal area of the impression in square millimeters. The plastics were conditioned at 21 deg. C and 65 per cent relative humidity for at least 24 hours prior to testing.

Results of indentation measurements

The data obtained for the Vickers indentation hardness of various plastics are shown in Table II. Each value reported is the average of 4 tests.

The styrene plastic was the most resistant to indentation of the materials tested; the cellulose derivatives were in all cases indented more readily than the resins. It is interesting to compare these values with the scratch resistance data presented in the same table. Very good correlation is evident for the cellulose nitrate, ethyl cellulose, and acrylate resin plastics. However, the scratch resistance values for the vinyl and styrene resins are much lower than the indentation values. In the case of the cellulose acetate samples, the two coefficients are not similar, although the indentation values obtained on different samples from a given manufacturer were substantially alike, just as were the scratch resistance values.

Some evidence was obtained in measurements of both scratch widths and the indentation diagonals that a few of the cellulose acetate samples were anisotropic, but the variation of the effects in the two directions was not sufficiently pronounced to warrant reporting the directional results separately. The data in Table II were averaged from measurements made parallel to the length and width of the sheets.

Standardization of test methods for plastics

A survey of the data in the literature on the properties of synthetic and natural resinous compositions, cellulose derivatives, and protein plastics indicates that it is very difficult to correlate the published values[2,3,4,6] for the different materials because of non-uniformity in the methods of testing. The industry is aware of this condition, and a number of its officials have urged that an investigation of test methods for plastics be undertaken in collaboration with the manufacturers' laboratories for the purpose of establishing standard specimens and procedures. The properties which have been suggested as requiring early consideration are hardness, impact strength, tensile strength, and stability to light. In the course of such a test program, comparable data relative to the properties of the various plastics would be obtained which would be of considerable value both to manufacturer and consumer.

TABLE II.—SCRATCH RESISTANCE AND INDENTATION HARDNESS OF VARIOUS PLASTICS

Material		Thickness mils	Scratch number kg/mm²	Vickers hardness kg/mm²
Cellulose acetate	1	63	8.2	7.9
" "	1	62	8.2	6.8
" "	2	56	7.4	5.6
" "	2	95	7.3	5.5
" "	2	125	7.5	5.2
" "	3	64	9.9	6.9
" "	3	95	11.9	7.7
" "	3	133	10.1	7.1
" "	4	162	5.3	7.0
Cellulose nitrate	1	67	9.9	11.6
" "	2	64	10.0	10.5
Ethyl cellulose	1	57	5.5	5.6
" "	2	29	6.3	6.7
Acrylate resin	1	116	15.0	13.6
" "	1	116	14.6*	13.6
" "	2	66	15.0	15.4
" "	2	76	18.3	19.2
Vinyl resin	1	56	10.2	15.3
" "	1	101	10.7	15.0
" "	1	100	9.7	15.0
Styrene	1	79	10.5	19.8

* 6 gram load

[1] Bierbaum, C., Metal Progress **18**, 42 (1930).
[2] Chem. Met. Eng. **39**, 656 (1932).
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[6] Modern Plastics, Insert 108–109, October, 1936.
[7] O'Neill, H., "The Hardness of Metals and Its Measurement," Cleveland, The Sherwood Press, 1934.
[8] Petrenko, S. H., Ramberg, W. and Wilson, B., J. Research NBS **17**, 61 (1936) RP903.

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